consists of three parts :—1, a centre, triangular point, or pin which serves as a guide ; 2, a thin shearing point or *nicker*, for cutting through the fibres ; and 3, a broad chisel edge or cutter, placed obliquely, for paring up the wood within the circle marked out by the point. There are a great many varieties of centre-bits : there are many boring-tools made with spiral stems, similar to the *twisted gimlet* (fig. 362), to enable the shavings to ascend the hollow worm, and thus save the trouble of withdrawing the bit so often. Of this kind is the *screw-auger*, fig. 365. There are an immense number of other tools which might be noticed, but we must refer the reader who desires to make their acquaintance, to the second volume of Holtzapffel's excellent work on "Turning and Mechanical Manipulation."

In the preparation of furniture, the taste of the artist may often be called into exercise, not only in promoting beauty of form, but in various carvings and inlayings. The French are distinguished for ornamental cabinet-work, especially for their *marqueterie* inlay, or the inlaying of woods of various tints in the form of flowers, ornaments, &c,; as also for their *buhl-work* (so called from M. de Boule, a French cabinet-maker of the reign of Louis XIV.), in which metals are inlaid on grounds of tortoise-shell or ebony. In some cases, ebony cabinets are inlaid with precious stones, and a variety of woods and metals surmounted with carved figures, with perspective recesses, and innumerable drawers, &c. We may also refer to the art of *veneering*, or the covering of a common wood, such as the surface of a deal table, with a thin slice of some beautiful and costly wood, so as apparently to convert the deal table into a mahogany one. Marqueterie work, when applied on a bolder scale to the production of floors, is called *parqueterie*, and when applied to the decoration of wall panelling, it is known as *tarsia-work*. Of late years, porcelain panels have been inlaid in furniture with good effect.

The work of the upholsterer usually follows, or is dependent, on that of the cabinet-maker, and a glance at the interior of his shop (fig. 376) will give an idea of the nature of his work.

A SMALL MOTOR.

In our last we drew attention to the want of small motors suitable to domestic and other such purposes. In this number we are able to illustrate for our readers a very useful form of engine and water motor, which is also applicable as a pump, and thus meets in many ways the wants of users of small power engines or of small pumps. It works on the principle of an oscillating cylinder, in which the opening and closing of the ports is operated by the motion of the cylinder itself.

The machine we illustrate in its multifarious forms (as it appeared in *Stummeur's Ingenieur*) is made by a M. Haag, of Augsburg, who has given every attention to the production of a machine most suited to its purpose, and his Haag engine seems to be now daily becoming more highly thought of and sought after on the continent. To give some description of our illustrations, Figs. 6 and 8, show a water-motor which only requires to be attached to a water main to start work at once. It consists of a cylinder *f*, in which a piston, *e*, works up and down, and its cross-head is attached directly to the crank of the fly-wheel shaft *g*. The cylinder oscillates on two large hollow trunnions of considerable diameter. These trunnions, whilst serving as supports to the cylinder, at the same time act as inlet and outlet passages to the water.

The water supply enters through the passage *a*, and through the middle part of the hollow trunnion bearings. In the trunnions are two oblong orifices *c*, *c*, which are brought alternately over the central passage by the oscillation of the cylinder. In Fig. 6, the engine is shown at dead point, the two ports in the trunnions are standing over the metal bridge between the central and the side ports, and are therefore closed. As the fly-wheel, by virtue of its momentum, passes over the dead point it raises the cross-head end of the cylinder and causes the left-hand trunnion port to be in communication with one of the outside ports *d*. These two exterior ports *d* and *d*, unite together and have a common outlet at *b*. The water-pressure is thus admitted to one side of the piston *e*, whilst the other communicates with the exhaust passage. The stroke from left to right is thus produced, and when the piston has arrived at the other end of its travel and the cylinder is carried down, the opposite effects are produced, and the piston is driven from right to left. In this way a continual motion is produced. If needs be, the inlet and outlet attachments may be interchanged, and by so doing the direction of rotation will be reversed. A further advantage from the form of construction is found in the fact that the water pressure tends to carry the weight of the cylinder. For when the pressure is admitted into the pedestals, it presses upwards on the under faces of the trunnions and thus saves any considerable wear or friction in the trunnion bearings. This water-motor utilises as much as 90 per cent. of the whole effective power, which is a very high percentage, most water-wheels not realising more than about 25 per cent. The following are concisely the special advantages of this machine. That the bearing faces have a very small weight or pressure per square inch, and will therefore last a long time. They are also easily lubricated and adjusted, and further, in large machines the under bearing can be removed and easily replaced when worn. The engine can be arranged in any position to suit varying circumstances.

In consequence of this easy adaptability to any circumstances, this engine could be usefully applied where no other could be used. In the Figs. 4, 5 and 8, the water engine is shown in a vertical arrangement, in which the principle of action is exactly the same as in the horizontal arrangement which has been a ready fully described. In Figs. 1, 2 and 3, however, the arrangement of horizontal steam engine is illustrated. In this, as in the water motor, the steam admission to the cylinder is through narrow ports *c*, *c*, in the trunnions and bearing, being conducted thence from the entrance *a*, through the hollow bed plate and bearing blocks. But with these ports as in the water engine, the steam would have admission during the whole of the stroke, and would not, therefore, work economically. To remove this defect a separate expansion valve is used, which is in the form of two oscillating semi-circular slides *s*, *s*, which moving backwards and forwards on the spindle *t*, can be made to close the steam admission ports at any portion of the stroke. The steam is thus expanded in the passages, trunnions, and thus finally in the cylinder. The oscillating motion of the expansion valve is produced by a small crank throw *b*, on the end of the shaft. The connection is not, however, made to a fixed pin, but to a block *o*, which is perforated with a screwed hole, and can thus travel up and down the screw *z*, in the middle of the slotted link. The exact required rate of expansion may thus be regulated and fixed by the position of the block on the screw thread, effected by turning the screw *z*.

A further ingenious automatic variable expansion has however, been introduced, by means of which the governor can at any time adjust the rate of expansion to suit the variation in the work. This is effected by introducing an intermediate rocking lever *y*, which rocks on the fixed centre *v*. This fixed centre, however, is not rigidly connected with the rocking lever, but the latter is free to move up and down by sliding in a slot upon a block surrounding the pin. Thus with a constant travel in the rod, P, from the crank-shaft, the travel of the rod P, to the valve may be made to vary, according to the position of the rocking lever on the fixed centre. The position of the rocking lever is regulated by the rise and fall of the governor. The cut-off is thus automatically altered by the action of the governor. It is thus seen that the Haag engine is also eminently suited for a steam-motor, as well as a water-motor, and can again be arranged with much facility either vertically or horizontally.

In Fig. 9, we show a third adaptation of this chameleon-like machine, which seems to be capable of any arrangement. Fig 9, is the combination of two oscillating cylinders working on the same crank-shaft in the centre. The one at A, is the steam cylinder, and the one at B, a water-pump, thus forming a direct-acting steam-pump. The arrangement is compact, and should be very serviceable for the delivery of large quantities of water.

A GOOD DENTIFRICE.—Perhaps the following may be useful to some of your readers ; it is the receipt for the tooth-powder known as Betton's. If the cuttle-fish be carefully powdered it will not injure the most delicate enamel :—Powdered cuttle-fish, 4 lb. ; powdered orris-root, 4 lb.; finest prepared chalk, 1 lb.; musk, 8 gr.; oil of rose, 48 drops ; oil of lavender (Mitcham) 48 drops ; carmine, 2 dr.; liquor ammonia, 5 dr.; water, 6 oz.