LATHE OVERHEADS.

By Rev. J. Lukin, B.A.

(For Illustrations see Lithograph Supplements.)

NO lathe can be considered complete until it has been fitted with an "overhead," the uses of which are many and various. A complete overhead converts an ordinary lathe into a self-acting or screw-cutting one; but apart from this there are much simpler contrivances which enable the workman to drive revolving cutters, drills, and saws for the purpose of grooving slotting mouldings and ornamenting work held in a chuck or between centres. The capabilities of a lathe are therefore vastly extended by this addition, and it becomes easy by its aid to shape accurately many-sided work, as well as that which is circular. The simplest overhead consists of a set of adjustable pulleys, generally two pairs, of which one is placed over the mandrel pulley, while the second pair is adjustable and can be fixed over any part of the lathe bed, and shifted at pleasure. It will not answer merely to screw the pulleys into the ceiling or into a beam over the lathe bed, because means must be found for keeping up the tension of the cord, the length of which varies according to the position of the slide-rest and size of the pulleys attached to the revolving spindle of the apparatus. For any one special job, however, such fixed pulleys may be made serviceable. It will probably occur at once to the mind of the reader that the easiest way to secure tension will be to suspend the pulleys by elastic cords, and such will answer fairly well; but for reasons to be stated presently they will not prove in all cases the most satisfactory method. At the same time, in writing specially for amateurs, I would suggest the propriety of pressing into service all and every kind of material that may be at hand, and to learn to adapt to a special purpose when necessary odds and ends of various materials which gradually accumulate in the workshop or in the house. To be brought up "all standing," as a sailor would say, because some requisite is not at hand, is the mark of an amateur destitute of resource and ingenuity, and to be able to meet an accidential emergency with skill and prompitude bespeaks a true workman. To begin with the simplest device of the kind, let a horizontal bar of iron, fig. 1, A, be fixed securely at a convenient height above the lathe bed; let it be a flat bar set on edge, and let the upper edge have a number of notches filed along it about half an inch apart and a quarter of an inch deep. Tie at the two ends of an india-rubber door-spring a pulley, such as can be bought of any ironmonger for 2d. or 3d. Do the same with a second door-spring, and hang them across the bar in such of the notches as will bring them into the desired position over mandrel and lathe bed. If the bottom of the notches are rounded off, the india-rubber will not be cut, and will last a long time. Another plan is to use four springs instead of two, tying pulleys to one end of each, and tying the other ends together with cord or wire, or linking them by a stout ring passed through the brass eyes of the springs. The sole object in this kind of overhead is to arrange fair-leaders or guide-pulleys to direct the cord from the fly-wheel of the lathe to the rotating cutter held in the slide-rest. The strain upon this cord requires to be considerable for driving such a tool as a milling cutter, for metal, while for ornamental work it may be much less, and these door-springs, some of which are very strong, will suffice. The pulleys will take up a position regulated by the direction of the tension, but will more or less draw towards each other, and will not in any case hang perpendicularly from the iron bar. Hence the necessity for the notches to prevent the cords or rubbers from sliding along the bar. Pulleys held thus by cords or lengths of elastic adjust themselves better than when they are made to run in orthodox brass bearings, and the lathe cord is, therefore, less liable to be fretted and worn out. I have, in place of the above, in an emergency screwed four pulleys, B, into an overhead beam just where needed, but there is here great difficulty in the management of tension. I generally have a 3in. plank overhead resting in a couple of supports to take anything requiring to be thus fixed. It often proves handy. Fig. 2 shows another of these unorthodox expedients, not, I think, in reality better, a little more troublesome to make, but just one degree more *en regle*. In this case the support is a round bar, preferably with nuts and screws, or at any rate shouldered by the reduction of the metal where it passes through a pair of brackets which attach it to the ceiling joist, or to such a plank as I have just spoken of. A pair of slides of wood or metal, B, with clamping screw at the top, enable the pulleys to be placed in position. These are as before slung by india-rubber door-springs. The best way to do this is to saw and chisel out a pair of recesses or notches to receive the brass eyes of the springs, and to run a bit of steel rod through from side to side. Another way is to bore holes, as shown at C; knot two bits of stout cord or gut into them, and to these attach the india-rubbers. All this may and ought to be neatly done, for though we may be often driven to inferior expedients, we should use them in a workmanlike manner, and when we have so fitted them, we shall often find ourselves sticking to what we at first meant to replace by some so-called superior contrivance. I have known an amateur, who may be labelled A1, using these pulleys screwed, not into the ceiling, but into a carpenter's bench brought up to the back of the lathe and adjusted to keep the cord tight, and with this simple appliance he has grooved large taps with a revolving cutter or mill in far better style than many of the bought ones. I mention it to show what a first-rate workman will use in the way of unorthodox appliances. The iron wire pins of these pulleys should always be driven out and replaced by steel ones of larger size, the holes being broached out to receive them. In speaking, however, of makeshifts, and home-made appliances, of which I may in all probability write frequently, I wish at once to explain that I am not disparaging or crying down orthodox lathe fittings and tools. These are in many cases far superior to any that can be rigged up at home (just as I would not myself counsel anyone to fit up the lathe illustrated in our last number, if one of ordinary design is to be had—I doubt if it would be even cheaper to make). But very often home appliances are matters of necessity, and if they will answer the intended purpose as well as more costly apparatus, it is not easy to see why they must be rejected; and they certainly are *not* rejected by practical mechanics.

We will now approach a step nearer to the orthodox. In fig. 3 the overhead bar is no longer a fixture, but is pivotted near one end to the upright A. This upright is of stout iron, ⅞ to 1 inch, and is fixed to the standard of the lathe, or from floor to ceiling, so as to be capable of revolution on its own axis to a certain extent. It may pass through a pair of eye-bolts, for instance, B, fixed to the lathe standards. This permits the whole gallows to swing round over the lathe bed or at any angle to it to assist in its adjustment. If, too, owing to the low ceiling, the overhead is not much above the lathe bed, this movement allows the whole to be swung out of the way of the workman's head when not in use. I have sometimes found this very handy. The upper part

of this upright rod should be made into a fork, in which the horizontal arm can be pivotted, and if a flat bar is used there may be a row of holes for the pivot, either of which may be used at pleasure to increase or diminish the leverage. If orthodox sliding double pulleys are used, as is the case in bought apparatus, the swinging bar is usually round, and turned up bright, and the pulleys are of gun metal. But the suspended ones, made as before, but with gut instead of india rubber, will answer just as well; and as in their case the actual pulleys can turn about in all directions, and are self-adjusting, they have a decided advantage of their own. Nevertheless here is room for choice, and if cords offend the eye, I have no doubt that the pulleys and their sliding blocks can be had finished or in the rough from some one or more of our accommodating lathe makers. Many of these makers have, of late, adopted the custom of selling castings of apparatus for amateurs to work up themselves, and will send working drawings too. This has sensibly broken through established custom, helped amateurs, and no doubt also pays the manufacturer—at any rate I hope it does so—as I do not see why he should be good-natured for nothing, I think, therefore, I may say that the pulleys, or any part of this overhead, are procurable separately, or the whole concern in a complete state by those who prefer to pay for it. It will be self-evident that an overhead of the above kind will be of limited application, and it is indeed solely used for driving rotary cutters. Tension is maintained by a weight suspended from the short end of the lever, and it will surprise the amateur to find what a heavy weight is needed to keep all taut. For this reason it should be suspended so as to hang but a little off the floor, in case of a mishap. The length of cord required for the overhead is somewhat of a drawback, and so is practically the lever arm itself, with its counterpoise; but when it is once arranged for work with plenty of tension on, and the pulleys oiled and nicely adjusted, the whole apparatus will work admirably, and it is on the whole about the best where expense is an object, and where no more is needed than means to drive at a great rate revolving cutters and ornamental drills. I have also used it to drive an emery wheel mounted on the lathe centres as on two dead centres, instead of using the mandrel in the usual way. Greatest speed is obtained, which is of importance in emery wheel grinding. We now pass to overheads, in which at least two cords are used, and which are capable of far wider application than those with a mere swinging arm and pulleys. In this arrangement, when in its simplest form, there are two upright standards attached to the lathe-bed, with bearings at the top for brasses, in which runs an axle parallel to the lathe-bed, carrying either variously-sized pulleys or sometimes one pulley like that on the mandrel, and a mahogany roller in place of any others. The standards require to be braced by a tie-bar, or by two, if they are high and slender. Mr. Hines uses cast iron ones of a light and elegant kind, with bearings of white metal. The Britannia Co., in the advertisement sheet of this paper, illustrate an overhead with round bar standards. Sometimes none are used, but a pair of cast iron hanging brackets affixed to the ceiling or overhead beam carry the axle of the pulleys, and this is in reality the better plan where it can be so arranged. I think I remember seeing in a catalogue of Churchill's that such brackets are sold there with the bar for axle turned and fitted, with or without the pulley and roller. Fig. 4 will sufficiently illustrate this apparatus. The pulleys must be bushed with brass tube and slide along the axle, to which they can be fixed by hollow keys, which saves the nuisance of having to file a flat all along it, or still worse, to make a slot, or fix a feather. The hollow back key is simply an ordinary one filed out lengthwise on the back with a rat-tail file, to make it fit nicely the convex surface of the bar. For a light shaft this answers well, but it would slip under a heavy strain.

In using this overhead we at once obtain a vastly extended range of speeds; and we can now drive with a cord to the pulley of the upper shaft from the fly-wheel, or from the mandrel; and we can take a second cord from the top roller or second pulley to one fitted to the screw of the slide-rest, which then becomes self-acting; the rate varying according to the sizes of the pulleys on the shafts. At first sight such an overhead appears to provide all that can be needed in the way of driving apparatus, but the real limit of its use is soon made evident in practice, and the addition of a second shaft parallel to the first is sure to be called for. By this second shaft much can be done which a single shaft renders impossible. For instance, one shaft driven from the fly-wheel may be geared by its second pulley to a revolving cutter, acting upon a cylinder turned and mounted between centres, or otherwise chucked. The second cord may pass from the mandrel to the supplementary shaft, and thence down to a pulley on the slide-rest screw, causing the cutter to traverse longitudinally along the work while it slowly revolves. In this way are cut variously shaped spirals in ivory and hardwood, and as the cutter is a revolving one, worked at a tremendous pace, soft wood may be manipulated as well as hard. If the respective speeds are right and a small disc is driven with a V shaped edge cut into teeth, a very perfect screw of any desired pitch can be thus cut in soft wood, which is difficult to manage at slow speed except with a keenly sharpened V tool and with special apparatus to guide it. The V tool can also be used here Details of screwing, however, I am not now speaking about. The range of speeds attainable by two shafts is very much increased in comparison with that which can be managed with a single one, and there is very little shifting of cords, or rather change of cords, required. The second shaft is carried in a frame pivotted on the screws or bearings of the first, so that the two remain equi-distant as this frame swings round to bring the rollers and pulleys into position, consequently if the pulleys which gear with one another are stopped alike but put on in opposite directions, the small end of one opposite the large end of the other, the same cords can be used from step to step with both pairs and yet a good range of speeds compassed. Fig. 5 represents this overhead in front and profile. It is not difficult to make, and well worth the trouble; the cost will depend upon the way in which the work is carried out. Suppose a roller to be used instead of a pulley, it should be of mahogany capped with brass, the latter enabling it to be fitted on with keys as if wholly of metal. Wood pulleys bushed are more satisfactory than metal ones, as there is less liability of the cords slipping: they will probably also prove easier to make. Mahogany or beech will do; but the former looks better, and is so. It is a pity wholly to sacrifice appearance to save a shilling or two, and I think, generally speaking, an amateur or professional who takes a pride in the appearance of his workshop will do better work than he who gets into the habit of putting up with apparatus of inferior appearance; otherwise beech will answer well enough for this kind of work, and may be stained and polished to imitate mahogany or left white, but in this case it soon gets dirty and has a disreputable aspect. In the case of the overhead of one shaft, in order to keep up tension, it is necessary to use a sliding bar carrying a tension pulley at one end, the other being weighted. This bar is pivotted upon the top tie-bar between

the standards when these are used. It is a matter of necessity to use something of the kind, as the cord could not otherwise be kept tight, but it absorbs power and makes the leg work harder. In the double-spindle overhead, the fixed axle may generally be used without this if care is taken to adjust the cord to the right length, and it is only the swinging axle in the frame that needs vertical motion to keep the cord strained; this is done by attaching a weight or weights to the opposite side of the swinging frame. For all ordinary lathe work of an ornamental character, and also for tap grooving, wheel cutting, and such like, the two overhead shafts are generally deemed sufficient, owing to the ease with which they are geared to produce the required rates of speed, and because they are capable of independent or united action. Most lathe makers supply them with their first-class lathes, and use the single shaft for the cheaper ones; but in spite of this, one of our leading amateurs has devised an overhead in which he uses in addition an intermediate or supplementary shaft, carrying its own separate speed pulleys. This shaft is, however, much shorter than the other two. I shall have to speak of this, however, in a future number.

DRILL-BOW AND FLY-WHEEL.

IN technical language the drill-bow produces an alternating circular movement, and the fly-wheel a continuous circular movement. From this it results that the drill-bow makes as great backward movement without effect as it does forward in producing it. Whilst the fly-wheel goes forward without loss of time, so that in reality it performs twice the work of the drill-bow during the same period. But this law has some exceptions, and we shall see by the examination of the different operations that sometimes the drill-bow performs as much work as the fly-wheel.

The drill-bow is the primitive process, not only for small work like that of watchmakers, but also for those of wood and metal turners. The latter did not use a drill-bow moved by the hand, but a flexible lath, more or less long and thick, according to requirement. This lath was firmly fixed, parallel to the ceiling, by its stiffest end; to the other end was attached the cord, which, after going round the pulley of the lathe, was attached to the footboard. Thus, both hands remained free, the force being communicated to the treadle by the pressure of the foot, assisted by the weight of the body; so that objects could be operated on of larger dimensions than when driven with the drill-bow held in the hand. Sometimes, instead of a lath, a bow was used, also fixed to the ceiling by its centre, and directly over the lathe; to the cord of this bow was attached another cord, which, passing round the pulley, joined the footboard, and the result was the same. Later on came the fly-wheel—that is to say, a wheel turning freely on its axis, and put in motion by means of a crank attached to the footboard. The periphery of this wheel was of wood, and it was little employed except for turning large objects; it replaced the pole and the bow mentioned above. Its weight was often insufficient, and had to be increased by attaching pieces of iron or lead. In addition, these fly-wheels were difficult to make properly; they were dear, and almost always warped out of shape. It is very probable this latter defect was the chief cause of their being little used, until the progress made in the manufacture of iron favoured the production of cheap wheels of all sizes, not liable to get out of shape, and realising the best mechanical conditions.

Before entering further into details, let us examine a little the subject of true turning. What is the necessary conditions for turning an object true?

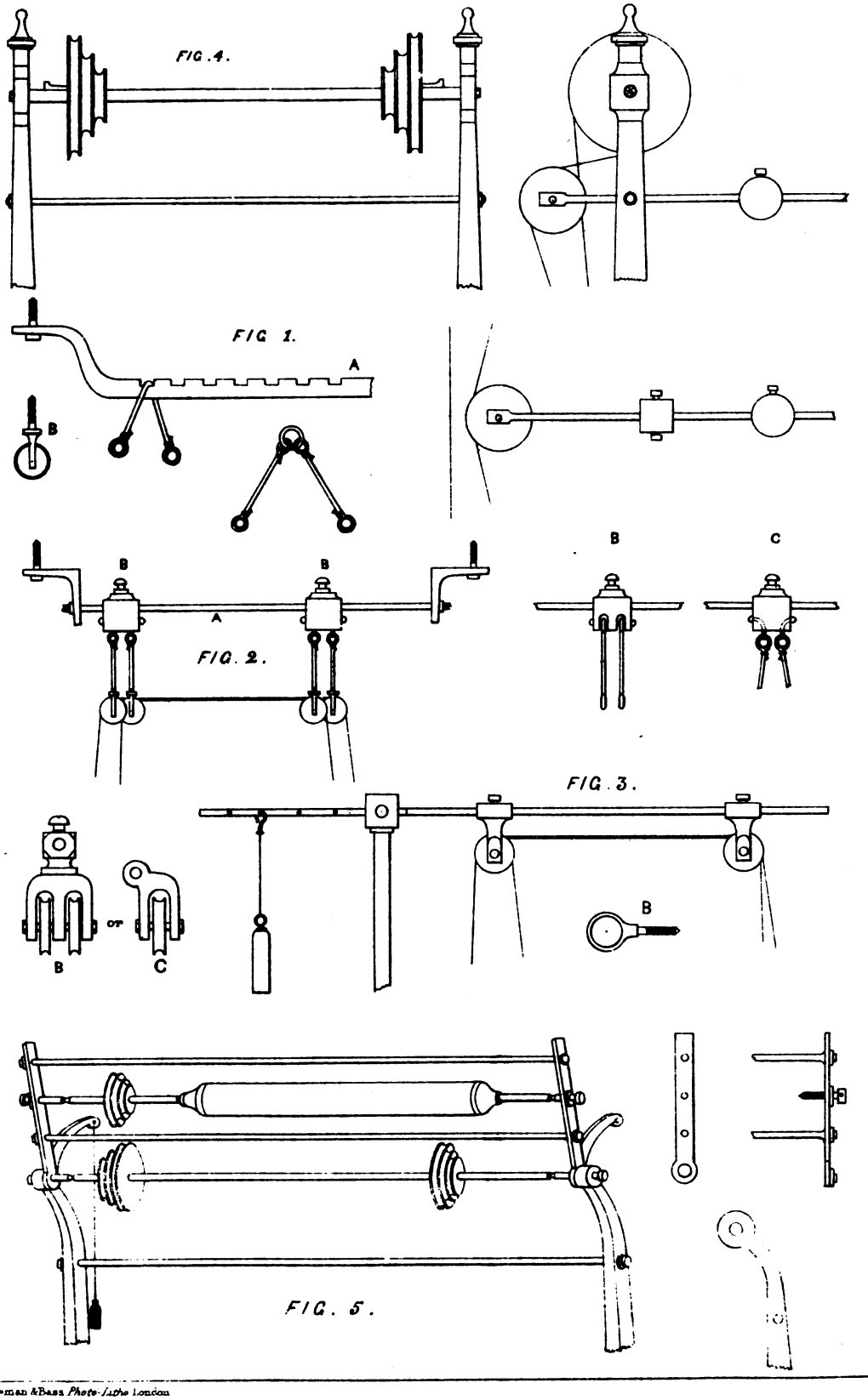
From an examination of these it appears, theoretically, that the fly-wheel turns truer than the drill-bow. But conscientious watchmakers have noted a contrary effect in practice; and this is a question which must be examined more closely, either to dispel an erroneous opinion, or to draw attention to whatever facts may present themselves. In turning with the drill-bow, the graver must cut while the oject turns one way, and be withdrawn while the drill-bow makes a reverse movement; the hand must therefore become accustomed to produce an alternative movement corresponding to that of the drill-bow. Where is the watchmaker who recalls with pleasure this period of his apprenticeship? In any case, he remembers the difficulty he had to turn true. After having succeeded and practised this method of turning for several years, what happens when the fly-wheel is tried? The alternating movement of the foot on the treadle replaces that of the hand working the drill-bow; thus the movement is transformed into a continuous one. The hand holding the graver, acting under the influence of habitude, continues its reciprocating motion until the necessary firmness has been acquired, According to the nature of the individual this change of movement is more or less rapidly achieved, during which time the turning is badly done. This is still further aggravated by the fact of the movement of the foot rendering the hand somewhat unsteady; for the foot having also an apprenticeship to make, works irregularly on the treadle, and destroys the regular inertia of the wheel, especially if this latter be light. Many watchmakers are deprived of the useful aid of the lathe from want of sufficient study of it.

Let us now see in what cases the use of the drill-bow is to be preferred to that of the fly-wheel, and *vice versâ*. Their operations may be divided into three categories—first, those in which either movement may be used indifferently; second, those which require an alternating movement; third, those necessitating a continuous one. The principal operations for watchmakers are—turning, drilling, polishing, and countersinking.

Turning is most frequently done with the drill-bow, but is very well executed with the fly-wheel, this latter being the most expeditious method. However, when it is requisite to give a rapid touch with the graver, as for instance in finishing, the drill-bow is preferable: when the operation is more prolonged the fly-wheel is best.

Drilling, as well as making small counter-sinks, is usually done as rapidly by one process as the other, provided that the cutting angles are properly shaped. For the drill-bow they should be in the centre of the thickness of the boring-bit, that is to say form two equal edges; the drill then cuts equally both ways, there is no time lost. The to-and-fro movement of the drill-dow has even the advantage of clearing away any particles having a tendency to adhere, especially when brass is drilled. With the fly-wheel the cutting parts of the drill should be formed of single bevels at the side opposed to the movement; half-round drills act better with the foot-lathe, because the two cutting angles are of necessity in reverse directions. When one cuts, the other moves the reverse way, and is easily splintered; care must also be taken to grind away the non-acting side, so that it does not touch the metal.

Polishing is done both with the drill-bow and the fly-wheel; but unless certain conditions be complied with the operation does not succeed, or it is performed badly. Steel objects are polished with the polisher or the emery wheel. Arbors are best



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