Simple power hacksaw for the small workshop

Edgar T. Westbury develops a machine which can be made with ordinary tools

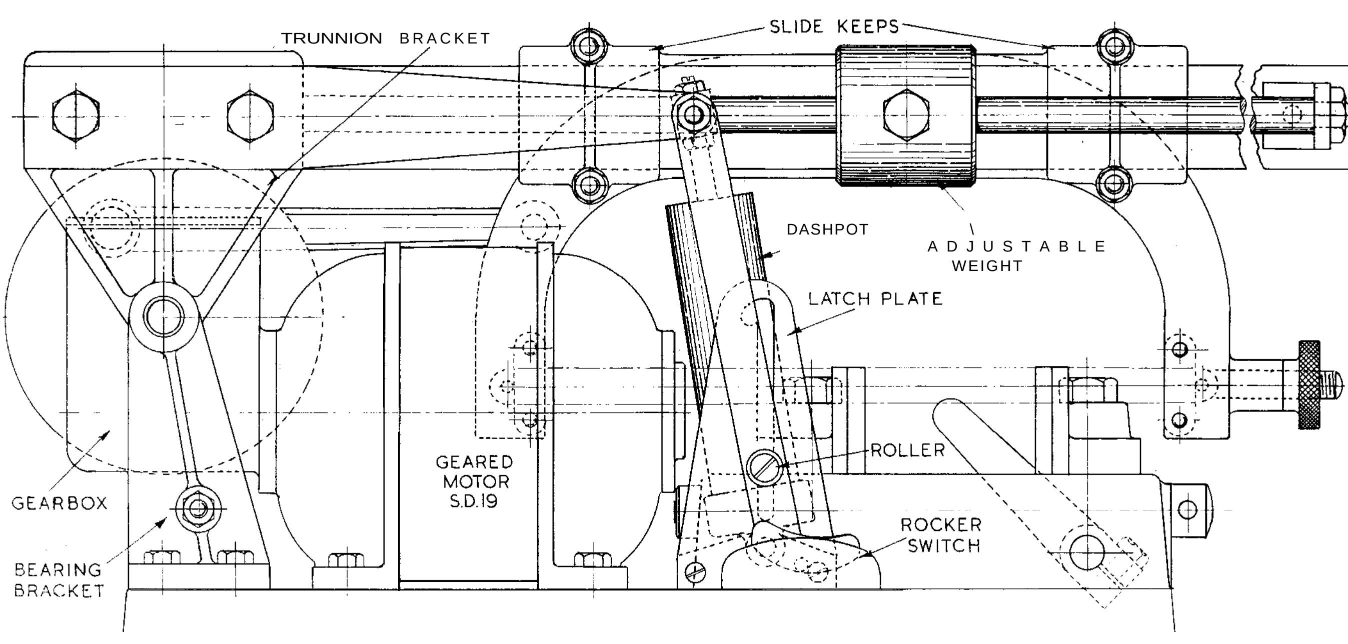
WHILE the ordinary hacksaw is an indespensable hand tool for all metal workers, the manual labour involved in operating it is tedious when a great deal of cutting has to be done on large metal sections. Even the owners of small home workshops often feel the need for a hacksaw driven by machinery.

Many ingenious schemes have been devised for applying power to saws originally designed for hand work. Those of which we have read in ME, though they differ in detail and complexity, all have some degree ‘of usefulness. Compact and efficient power hacksaws can also be bought, and are used in many industries.

To the amateur who likes to build his own workshop equipment, the making of a power hacksaw is an attractive proposition. But how can the existing designs be either simplified or improved ? This is a matter to which I have given a great deal of thought, and experiment. My main object has been to reduce the overall size of the machine, and the problems of its construction, in relation to its range of general utility.

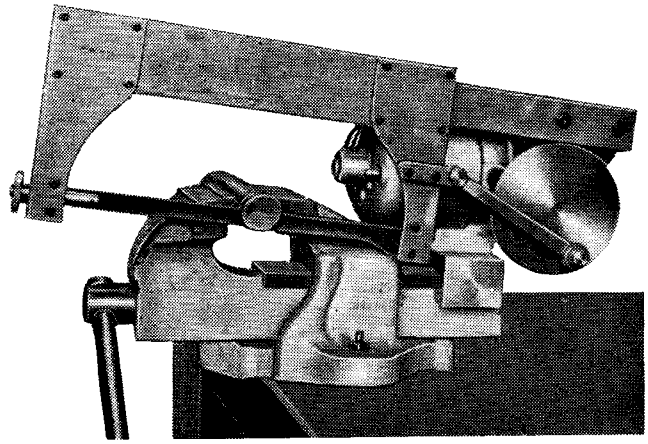
In applying power drive to any machine tool, we must consider the problem of transmitting it efficiently at appropriate speed and torque. If the machine is intended to be portable-not confined to a fixed position in the workshop-the only form of practicable motive power is an individual motor of some kind. Fractional horse-power electric motors of suitable size can be readily obtained, but the methods of applying them -often leave something to be desired. Generally speaking, hacksaws need to be run at low speed, and this calls for a considerable ratio of reduction from a motor of the normal type. The standard induction motors run at speeds of about **1,425** r.p.m. Motors of 950 r.p.m. are relatively expensive, and still do not entirely eliminate transmission problems.

It has always seemed to me that the transmission system is the Achilles' heel of most small power hacksaws. In an experiment which I made some years ago, with a machine driven through a two-stage reduction by a 1/2 in. V-belt, the secondary drive was very liable to slip and stall the saw unless it was kept uncomfortably tight; eventually I used a double belt for this stage. Alternative forms of transmission



which have been widely employed include belt-cum-gear reduction, or high-ratio single-stage flat belt. Yet another expedient is to tolerate the running of the saw at a rate which is practicable but is not ideal for maximum working life.

For a high ratio of reduction in a single stage, the obvious form of transmission is worm gearing. I am surprised that more use is not made of it. Some forms of worm gears are not very efficient, and may have given this system a bad name in the past, but the modern ones, with due provision for taking end thrust, and good lubrication, work with very little power loss. There is not much that can go wrong with properly fitted gearing; it is dead silent, and a further advantage is that it takes up much less room than any other practicable transmission system. It can therefore be used for a compact and completely self-contained unit.



Vice attachment

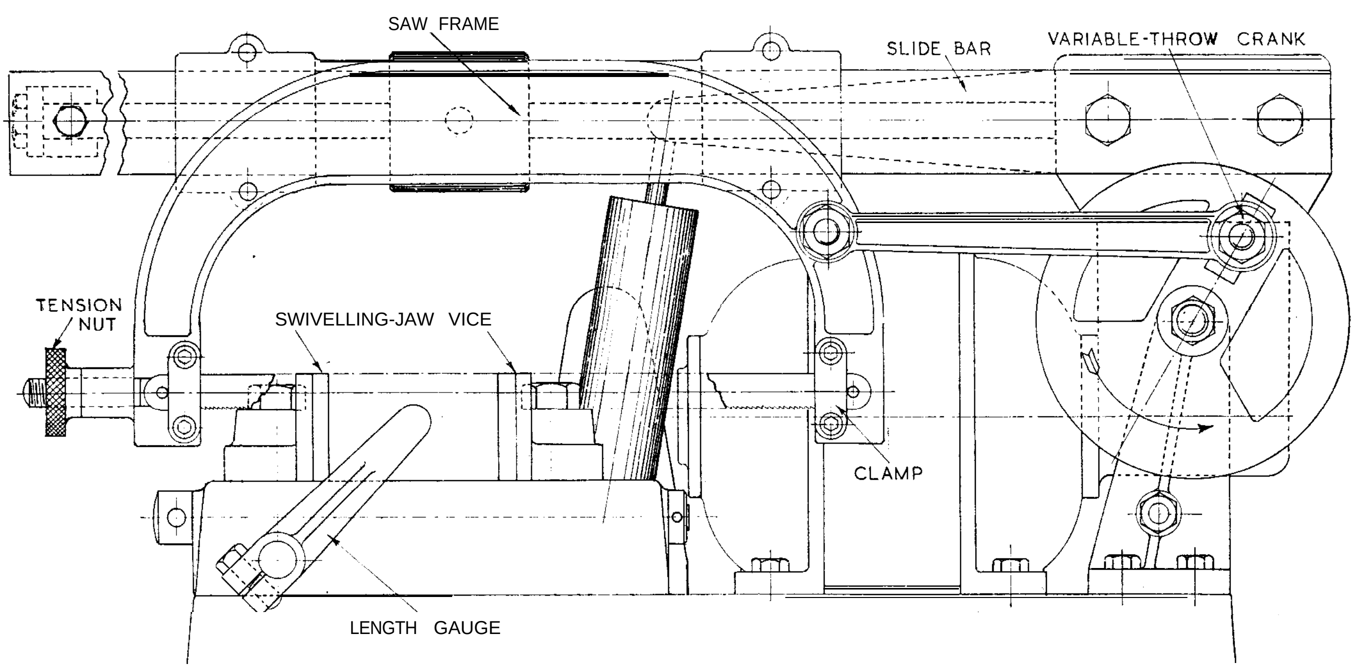
In one of my experimental machines I exploited the compactness still further by attaching the working parts of the saw to an ordinary bench vice. The geared motor was mounted on a clamp which fitted the rear extension of the moving vice jaw; and the saw frame, built up from steel plates, was driven from a disc crank on the worm gear shaft. Concentric with the housing of the shaft ‘bearing, a trunnion frame carried a long rectangular bar which formed the slide for the saw frame.

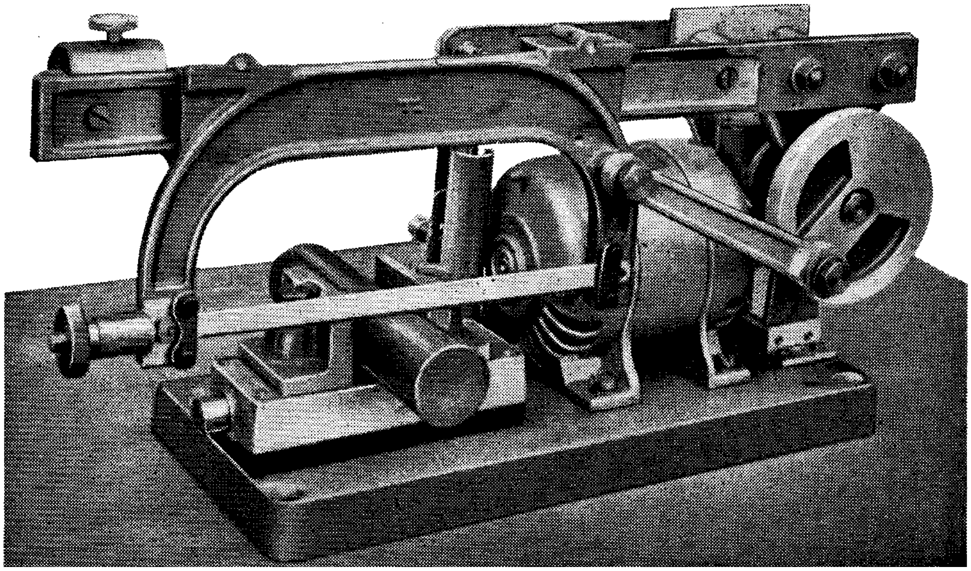
This machine, shown here at work, could be kept more or less permanently in position, except when the full capacity of the vice jaws was required. The trunnion movement allowed the frame to be turned right back out of the way when the saw was not in use. I provided a knock-off switch of the simple push type.

The small motor supplied ample power. But as it was a series-wound universal unit, its speed varied considerably with the load. This was a disadvantage, as the saw would race away on a light job, and slow down to a mere crawl when a man-sized piece of metal had to be tackled.

Still, this crude machine did much useful work and led to the development of the present form, which has several features in common with it but is more complete and efficient. Its construction involves no difficult machining operations, and can be carried out with the limited equipment of the small workshop. The motor employed is one which can be obtained from stock, complete with the worm gearing, in a self contained unit; it is of the capacitor-induction type, which has a good starting torque and substantially constant speed under varying load. Though it is more expensive than an ungeared motor of comparable power, the elimination of extra transmission accessories largely cancels the difference when we consider the cost of the complete machine. We can also use a plain motor with a worm gearbox coupled to it, or we can make up the gearing from available components. The reduction ratio is 15 to I, giving approximately 95 working strokes of the saw per minute.

From my experience with the earlier machine, I found the single bar slide for the saw frame to be quite satisfactory and so I have retained it. Much more elaborate slides are often used for power saws, but whether they do anything more than increase friction is open to question, unless the





Side view of the prototype machine which has now been modified

machine is designed to work with high precision. Generally speaking, this is not necessary, as in any event the sawn surfaces of workpieces usually have to be machined afterwards.

The machine will cut a 2 in. bar within 1/32 in. of squareness, which is equal in accuracy to most commercial units. It is, of course, essential that the saw frame should hold the saw truly parallel to the line of travel and that the vice jaws should be square with it. Provision is made for swivelling both the vice jaws for angular cutting, or holding tapered work. To swivel the complete vice is practicable only within small limits, without the fouling of one or other of the jaws. A useful fitting to the vice is a horizontal bar on one or both sides, to carry either a length gauge or a support for overhanging lengths of work.

Regulation cutting load

For the saw frame we use a rigid light alloy casting which needs no elaborate machining; most of the work on it can be done by hand tools. This applies also to the slide keeps, which retain the frame in working contact with the slide bar, and provide some measure of adjustment for wear. As the saw is designed to cut on the back stroke, the connection of the frame to the driving crank is arranged to produce a downward thrust on this stroke, and relieve the load on the saw (though without actually lifting it) on the return.

Cutting load is applied by gravity, and the load required varies according to the material, its thickness, and the quality and condition of the blade. An adjustable weight is therefore fitted alongside the slide bar, to vary the leverage on the frame. The slide bar is carried on a trunnion frame with bearings on each side of the worm gear shaft, and co-axial with it. In the original design, I intended to mount the trunnion brackets directly on the outside of the shaft bearing housings, but the geared motors obtainable did not provide enough material in the bearings to allow this to be carried out properly. I therefore had to provide extra bearing brackets, outside the gearbox bearings and lined up with them.

The fitting of control gear to limit the rate of downward movement, or feed, of the saw is not absolutely essential but is very helpful. Besides reducing the tendency of the saw to snatch or chatter, it prolongs the life of the blade. The simple hydraulic damper or dashpot fitted to many types of power saw, is moderately effective for this purpose, particularly if we provide the means of regulating the rate of movement by an adjustable leak valve. Free upward movement of the saw frame is allowed for by a non-return disc valve in the dashpot piston. The dashpot cylinder is free to articulate, to allow its piston rod to follow the arc of movement at the top end, where it is pivotally attached to the radial arm on the offside trunnion bracket.

A support arm also pivoted at the same point, serves the double purpose of propping up the saw frame when it is not in use, and operating the switch to stop the motor at the end of a run. Depressing one end of a finger lever works the rocking switch; a roller on the support arm is arranged to come into contact with the lever and stop the saw at the end of its travel. After the saw frame has been lifted and the machine is ready to take another cut, we can restart the motor by depressing the other end of the switch lever.

Portable unit

The machine is mounted on a cast metal base and its weight complete is 30 lb. It can therefore be transported easily. But it is quite stable when working, and does not need to be fixed down on the bench. The frame takes any standard 10 in. hand saw blade; I do not see any advantage in the use of shorter blades in a utility machine which is generally called upon to cope with the maximum possible size of material. High-speed steel blades are the best-quality always proves most economical in the long run-but the machine will give quite good results with common carbon steel blades, provided that it is not geared to run at a higher speed than the one specified.

It will be clear from the general description that there are a number of optional features in the design, and that the machine can be constructed in various ways. The use of castings for most of the parts is recommended, as they reduce the amount of work and generally produce a better-looking result. Sets of castings and complete geared motors can be obtained from Woking Precision Models Ltd, Victoria Road, Woking, Surrey.

To be continued