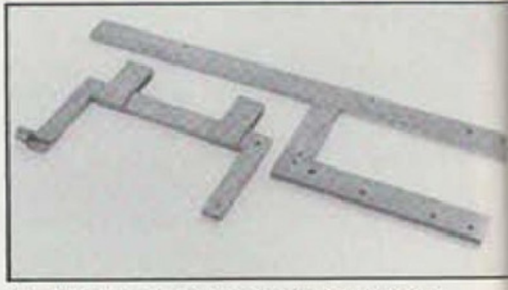
A POWER HACKSAW



The 'H' frame and saw frame. Parts here are welded but could be silver soldered, brazed or, with adaptation, bolted together.

Hacksawing of metal by hand can be both time-consuming and very hard work. There have been many power hacksaw designs described over the years. This one by John Brittain is made from stock materials and some welding is involved, although no doubt other methods of construction could be employed. A right-angle drive geared motor supplies the power. It is unlikely that readers will be able to obtain the same motor and gearbox but there are suitable ones on the market, often as second-hand or surplus bargains — worth looking for and freely available is the Parvalux. One particular asset of this design is the use of a dash pot; this relieves the strain on the blade on the return stroke and makes for a smooth-running piece of equipment.

Bracket which supports the motor. Readers will probably need to modify this in detail to suit their particular motor.

It all began with a visit to a car boot sale. Like many others who believe that one man's rubbish can be another's treasure, I enjoy browsing round such places where I frequently pick up the odd item for the workshop. On one such occasion, I happened to spy the rear end of an electric motor sticking out from beneath a pile of 'goods'; further examination revealed that the other end possessed a worm gearbox, which immediately prompted the thought 'power hacksaw.'

The princely sum of £1.50 changed hands and I bore my new acquisition home where I was able to check it in more detail. Alas, the awful truth was revealed for, not only did the motor need 110 volts to drive it but, upon checking the stator windings, I found that one of them was 'blown.' Consoling myself with the thought that 'you can't win 'em all', I hove the offending article into the back of the garage and forgot about it.

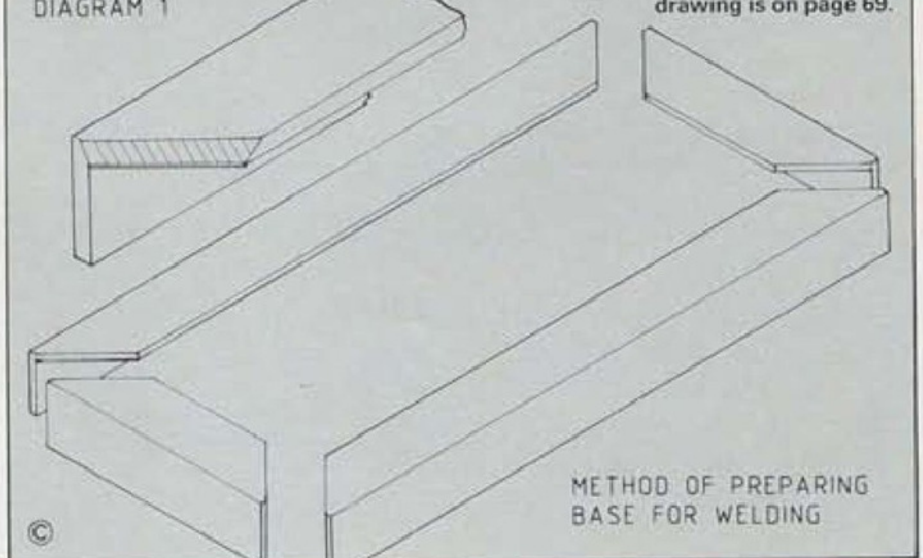
Some months later, I was rooting about amongst my accumulated junk when I unearthed an electric motor which I had 'put into store' some ten years earlier and which now reminded me of my unfortunate purchase. An idle thought flitted through my mind. 'I wonder whether the bolt holes of the two motors happen to coincide?' A quick check with a pair of dividers indicated that indeed they appeared to do so and I was galvanised into renewed enthusiasm. Taking the two motors to the workshop, I confirmed that the bolt hole centres were a perfect match and began to work out how the pair could be combined so as to form a single 240 volt unit with gearbox attached. After due cogitation and an examination of the sizes involved, I decided that it might be possible to remove the worm from the gearbox motor, mount it on the shaft of the other one and thus marry the two units together.

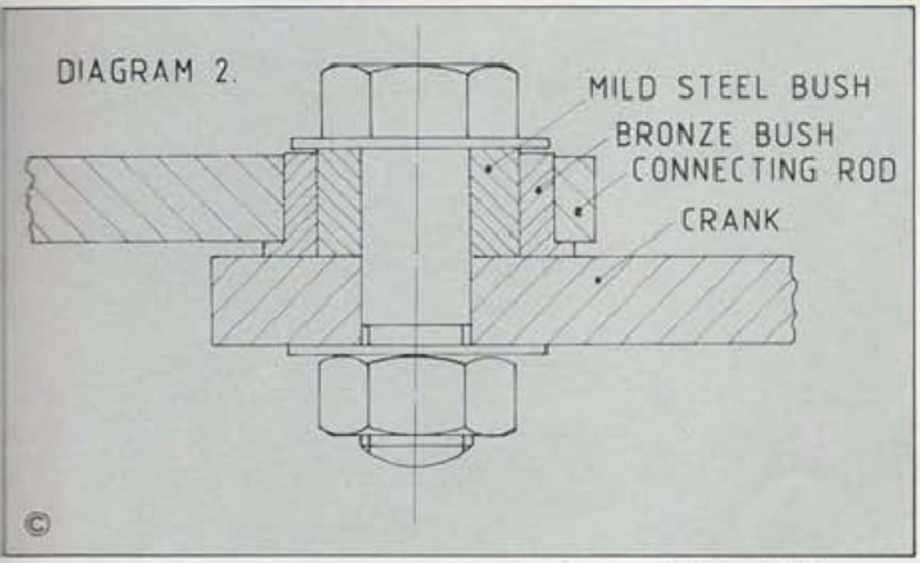
As far as I could ascertain, apart from minor modifications to the gearbox motor casing in order to accommodate the second one within it, the only other alteration necessary was to provide longer studs with which to bolt the two items together. However, by far the most taxing problem concerned the worm, which was integral with the rotor shaft and, as expected, found to be dead hard! How far down the shaft did the hardness extend? That was the question. I tested it with a file and was relieved to find that the portion needing to be bored appeared unhardened. I cut off an appropriate length of shaft, complete with worm and ballrace and, chucking it very carefully in the lathe, prepared to drill and bore. Half an hour later, after making haste very slowly (no second chance in cases like this) I had obtained a tight push fit on the shaft of the second motor and was gratified to note that, upon testing, the worm ran truly. A pair of grub screws tightened on to the flat of the motor shaft secured the worm in position after which, once the stator windings had been removed from the gearbox motor, the two 'halves' could be fitted together.

This was accomplished surprisingly quickly and so easily that I began to suffer from that feeling of impending disaster which I'm sure we all experience from time to time when things are going just too well – but no, Lady Luck was well and truly on my side this time and I completed the assembly without mishap. Upon switching on for the first time and seeing the motor whirring away happily with the gearbox shaft turning in silent unison, I indulged myself in a few moments of quiet satisfaction before turning to the question of the hacksaw design.

The mounting for the original motor was in the vertical plane and consisted of a sturdy bracket fixed to the side of the gearbox. I felt therefore that there was little point in altering the arrangement and concluded after some thought that this

N.B. The General Arrangement drawing is on page 69.





The assembled base. As noted, it may be necessary to modify yours slightly to fit whichever motor and gearbox is used.

feature should ultimately dictate the principle upon which the whole design relied. Accordingly, I decided that the main frame should take the form of a letter 'H', so that the two parallel arms could carry the motor at one end and the other end be used to mount the saw frame.

A shouldered shaft, bolted to the lower edge of this 'H' frame could then be employed to pivot the frame on the base. I drew out several full-size arrangements on a piece of veneered chipboard before settling for a design which allowed the gearbox to overhang the end of the base. Having always admired the extremely neat and compact Westbury hacksaw, I was reluctant to face my gearbox 'outwards' but concluded that I must do so after giving due thought to the disposition of all components.

Base construction

Since the obvious method of joining the 'H' frame would be by electric arc welding, I determined that, wherever practicable, I would use this form of construction throughout the project. I had access to a quantity of black mild steel angle which had seen service in a number of jobs and contained quite a selection of assorted holes. However, by picking my way between them, I managed to obtain enough material from which to construct the base and made a start on this item by first cutting the four pieces to length and then cutting the corners off at 45 degrees. I then prepared each 'mitred' edge for welding by filing a generous bevel (see **Diagram 1**). I laid out the four pieces upside down on a flat surface, 'spotted' each mitre in the centre to hold the joint temporarily before turning the whole thing over and welding all the joints, first the mitres and then the corners. For those unfamiliar with the technique, this is a very good method of constructing a frame from angle iron and results in a job which is well-nigh indestructible and which has many obvious applications.

This done, I welded a cross-member part-way along and flush with the top edge of the frame, the main purpose of this piece being to support the vice runners. These two items were soon welded into position, after which I turned my attention to the pivot shaft and bushes. The shaft was turned from [illegible] in. diameter bright mild steel, shouldered at both ends and threaded [illegible] in. B.S.W. ready to be bolted to the 'H' frame. The bushes were turned from 1[illegible] in. diameter B.M.S. and bored to fit the pivot shaft. They were then slid on the shaft and clamped at their correct location before being welded in position at the end of the base.

'H' frame

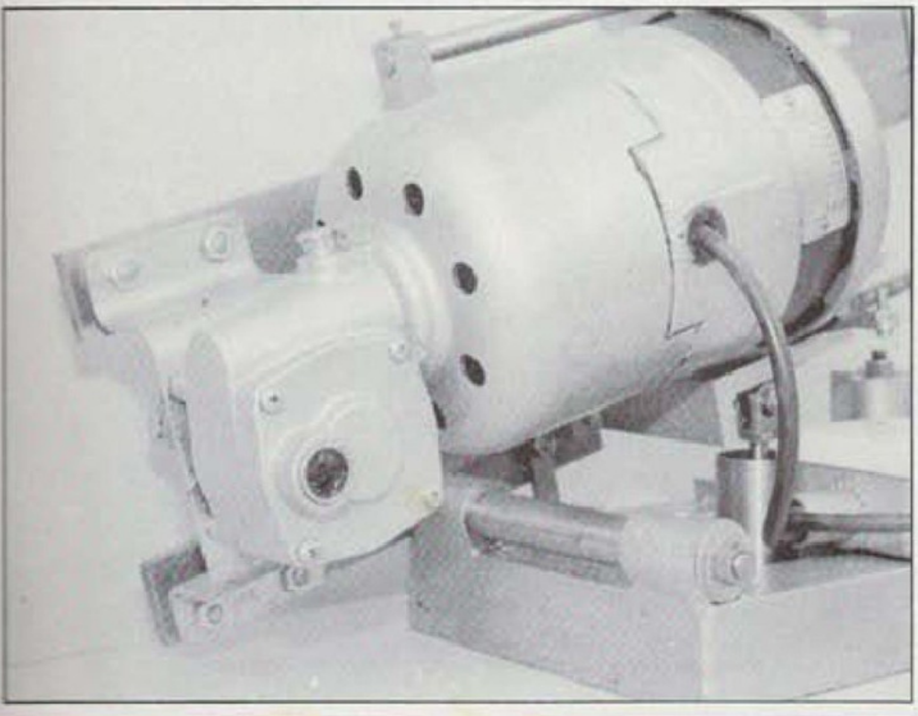
The 'H' frame was next on the list and this was constructed from 1[illegible] in. × [illegible] in. B.M.S. Now the side surfaces of this component needed to lie in the same plane if the machine was to be expected to work accurately and I was mindful of the distortion which would probably take place whilst the welds were cooling and shrinking. To minimise this, I first tack-welded each joint, turned the whole thing over, ran both welds and then turned it again quickly in order to complete the welds on the first side before too much cooling had taken place. I then waited until the job had become completely cold before inspecting for accuracy. Inevitably there was a small deviation from the truth but the judicious use of a large hammer, a block of wood and a blacksmith's vice straightened matters! Not exactly precision engineering but nevertheless quite effective in this case.

Saw frame

The saw frame came next and here again I employed welding as a means of joining the three main components together. However, the 'keep' plates were assembled by a different process. I first positioned a pair of 2 in. × [illegible] in. B.M.S. pieces on the frame, held them in place with toolmakers' clamps, drilled and riveted them with [illegible] in. dia. countersunk rivets. Having fixed the second pair likewise, I then slid the 'H' frame between both pairs before positioning 2 in. pieces of [illegible] in. square bright mild steel between their top edges which were protruding above the frame. Again, holding these pieces in place with clamps, I drilled right through each in turn, countersank and riveted (after first removing the 'H' frame). A little careful draw-filing on the 'H' frame produced a smooth sliding fit between the two components.

Crank and connecting rod

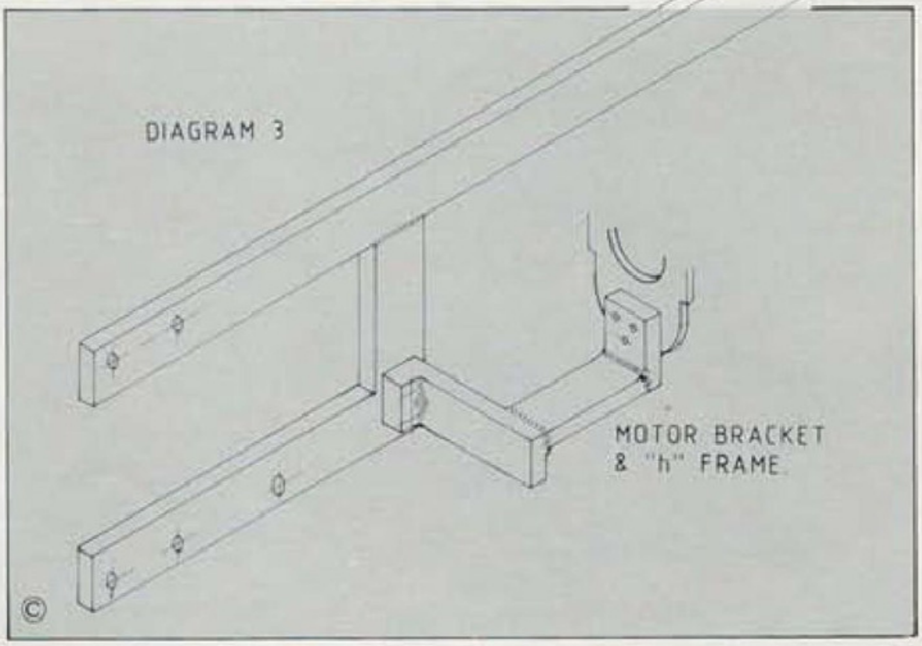
When I obtained it, the gearbox drive shaft held two sprockets which I removed,

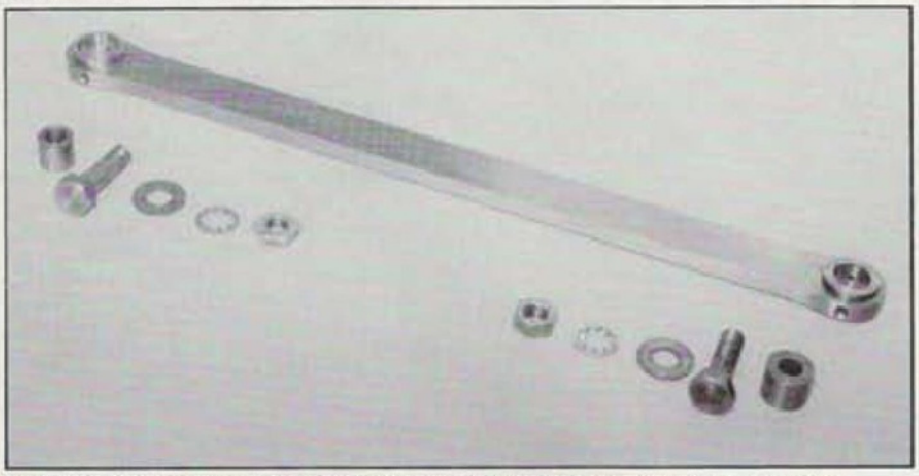


A close-up study of the swivelling arrangement for the motor and gearbox.

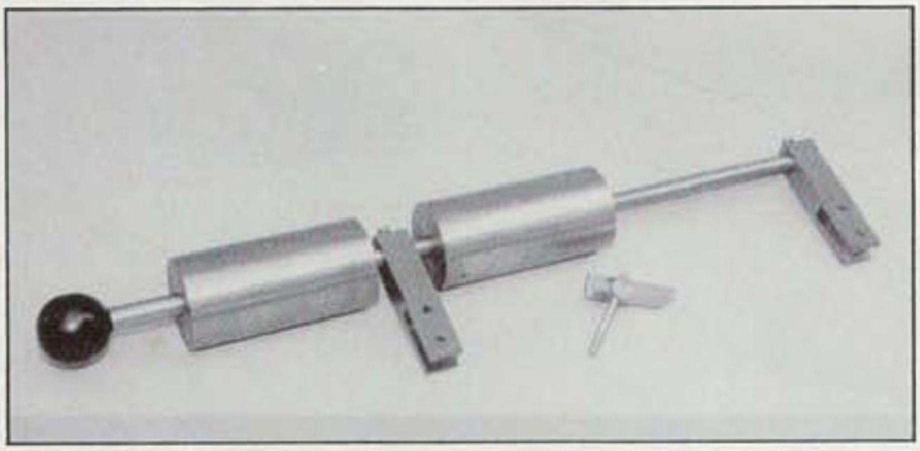
leaving a [illegible] in. dia. shaft some 4 in. long. After shortening this, I bored a 2 in. length of 1 in. diameter bright mild steel (B.M.S.) to be a tight fit on it and formed a crank by silver soldering a piece of 1 in. [illegible] in. bright mild steel across one end of the bush. I was thus able to utilize the same method of fixing the crank to the shaft as was used to hold the original sprockets in position and, in fact, used the same pin and hole through the shaft. To ensure accuracy of this component, a [illegible] in. diameter stub mandrel was turned to mount it on whilst taking a light facing cut over the outer surface of the crank.

The connecting rod was made from 1 in. × [illegible] in. bright mild steel, being clamped squarely under the toolpost whilst being bored for its phosphor bronze bushes. Since I had the use of a horizontal milling machine, I used this to reduce the width between big and little ends before completing the shaping by filing. The flanged bushes were a straightforward turning and boring job and made to be press fits in the connecting rod. I decided to dispense with the usual form of crankpin in favour of using a plain mild steel bush which was made three or four thousandths of an inch longer than its mating bronze bush and used in conjunction with a bolt, nut and washer to retain the connecting rod assembly in position. (See **Diagram 2**.)





The connecting rod which controls the operation of the saw, together with its bushes.



Counterbalance arm and weights. With any alteration to the basic design, some further slight adjustment may be needed here in order to achieve smooth operation.

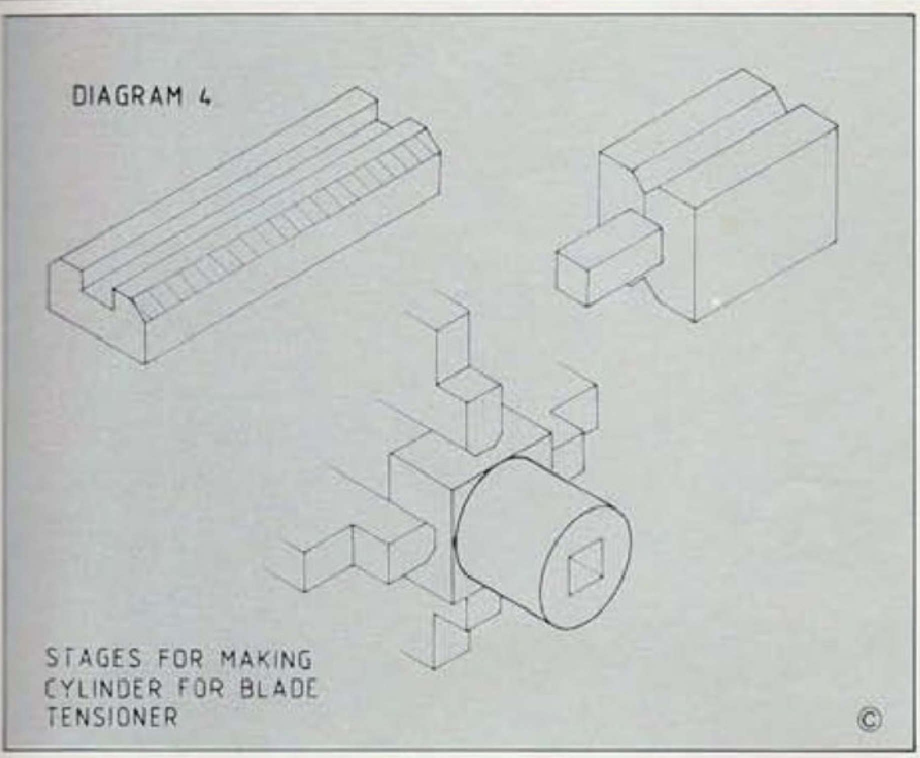
Motor bracket

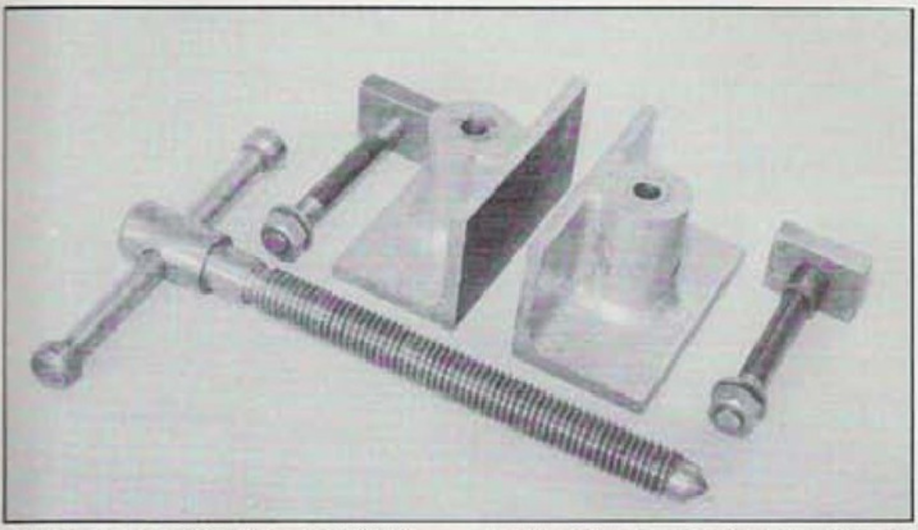
The obvious means of supporting the other end of the motor was by using the resilient mounting. Accordingly, a bracket was welded together from pieces of 1[illegible] in. × [illegible] in. B.M.S. in a configuration which allowed it to be bolted to the inside of the 'H' frame and be positioned centrally beneath the motor where the motor support plate could be fixed to it. (See **Diagram 3**.) I also had in mind that, should I fit a dashpot, this bracket might also serve as an anchor point for the piston rod. At the time however, I was doubtful whether I would be able to incorporate this feature since lack of space appeared to preclude it.

Blade fittings

A 4 in. long piece of [illegible] in. × [illegible] in. B.M.S. was milled down the centre for a depth of [illegible] in. with a [illegible] in. dia. cutter and then bevelled generously on its two outside edges adjacent to the groove. (See **Diagram 4**.) The piece was then sawn in two and the two halves held together in a vice ready for welding; a scrap piece of [illegible] in. square B.M.S. was used to locate the two halves. After welding the 'Vees' formed by the bevelling, the now [illegible] in. square component was placed for half its length in a four-jaw chuck, set to run truly by the [illegible] in. square scrap and turned down until no evidence of the flat sides remained. A [illegible] in. length of this turned portion was parted off and I was now in possession of a neat little cylinder with an accurate square hole running down its centre. Again, for those not so familiar with welding, where applicable, this technique can be recommended as being splendidly quick and, of course, far superior to any attempts at forming square holes from round ones with a file.

One of the saw frame ends was placed in the milling machine and a [illegible] in. × [illegible] in. groove cut across it near the end, after which the aforementioned cylinder was clamped on the outer edge of the frame with the square hole located in relation to the groove in the frame by means of the same piece of [illegible] in. square material. A quick blast with the welding rod and the two items were fixed firmly together and ready for the blade tightener. This last consisted of a 2[illegible] in. length of [illegible] in. B.M.S. (the same piece which had done all the locating) and milled for half its thickness for a distance of [illegible] in. It was then placed in a four-jaw chuck and the other end turned for a length of 1 in. to a diameter of [illegible] in. (or until the flats just disappeared). A [illegible] in. B.S.W. thread was run on as far as it would go, after which an [illegible] in. diameter hole was drilled in the centre of the milled portion. I countersank this hole lightly on the milled side so as NOT to leave a fillet of silver solder (the blade would waggle about on this) before soldering a 2 in. piece of [illegible] in. diameter B.M.S. rod in it. I then bent the rod 'inwards'





The parts for the vice; it can be used to cut metal at angles other than right-angles.

slightly so as to form a hook, which would tend to make the blade seat firmly against the milled surface when tightened. After bending, the rod was cut off to final length.

Wing nut

For this item, I adopted my standard procedure for making wing nuts, which is as follows:

Taper turn a 2 in. long piece of [illegible] in. diameter B.M.S. for a length of [illegible] in. or so. Clamp squarely under the toolpost and slit centrally with an [illegible] in. slitting saw to the depth of the taper. (See **Diagram 5**.) Strike a [illegible] in. radius semicircle on a piece of [illegible] in. B.M.S., cut out and file to shape. Assemble the two pieces (making sure that they are an easy fit or the solder won't penetrate) flux and silver solder. Check that the solder has run right through the joint on both sides. Shape the wings by first filing a semi-circular depression in the centre and then shaping the ends; final shape is obviously dictated by personal taste. Grip chucking piece in three-jaw, centre drill, drill and tap ([illegible] B.S.W. in this case). Part off at base of taper.

Vice

The vice jaws were made from 4 in. lengths of 2 in. ×2 in. ×[illegible] in. black mild steel angle. A 1[illegible] in. piece of 1 in. diameter B.M.S. which had been axially drilled [illegible] in. diameter was then welded in a central position on each jaw and the [illegible] in. diameter hole continued right through. Pieces of 1 in. × 1 in. × [illegible] in. B.M.S. were drilled through the centre and welded to the heads of a couple of 3[illegible] in. ×[illegible] in. diameter coach bolts (with the square bit under the head removed). These were then used to bolt the jaws to the runners, the square "heads" being necessary in order to locate against the base edge to prevent turning.

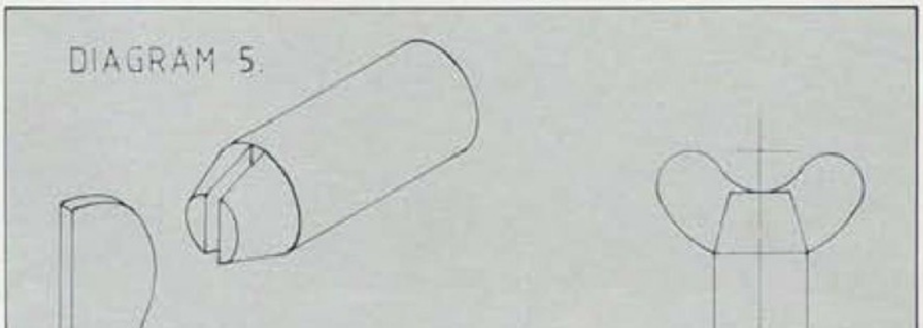
The vice screw was rescued from a long-since discarded woodworker's vice and, after suitable titivation including re-screwcutting the thread and turning the end to an included angle of 90 degrees, was matched with a new nut. I provided a shoulder on the nut and made it a press fit in a 4 in. length of 1[illegible] in. ×[illegible] in B.M.S. which had been bored to receive it and filed concentrically semicircular with the hole. This component was then welded in position on the end of the base in the centre of the runners. The conical end of the screw was used to mark a position on the nearer vice jaw which was then countersunk to receive it.

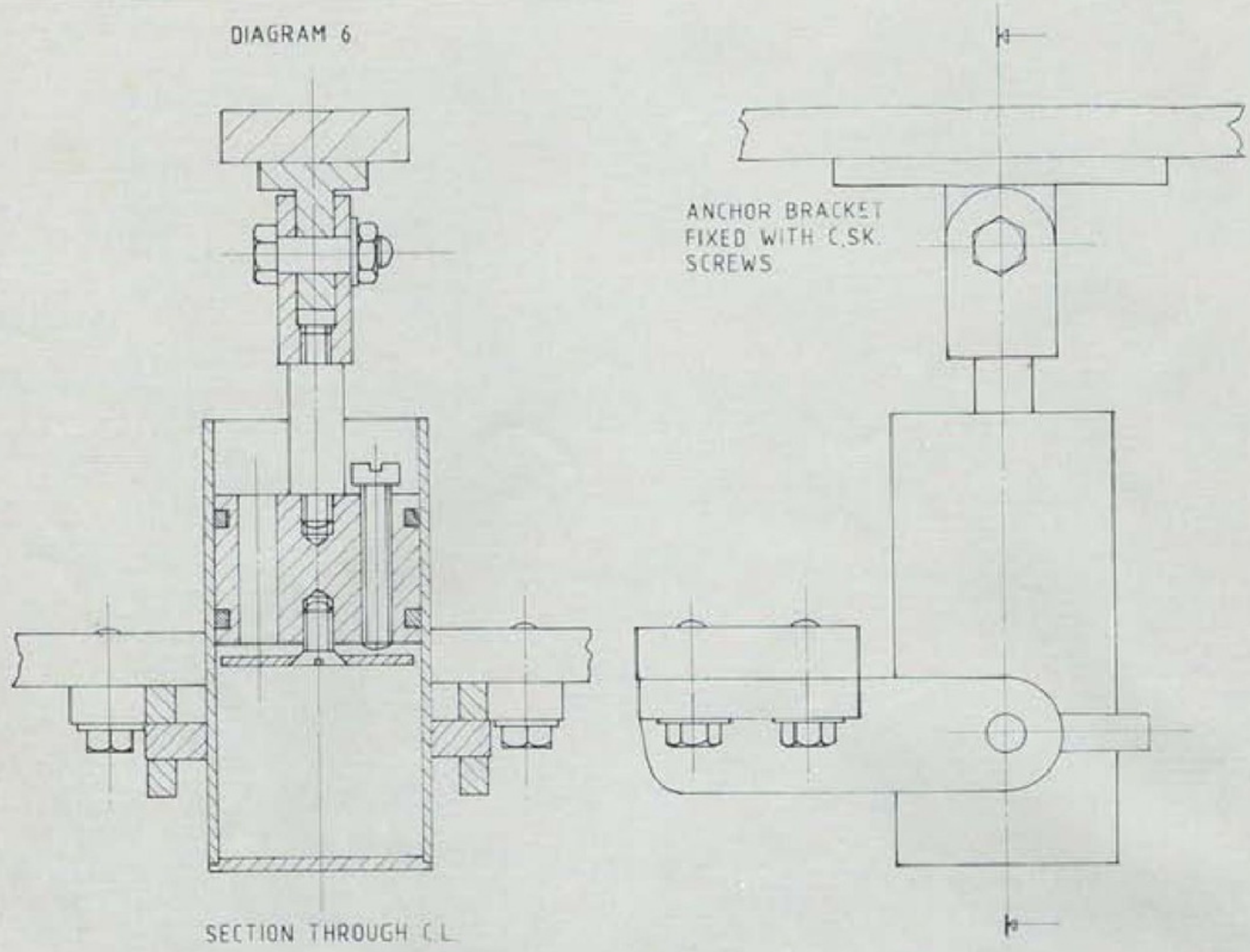
Lifting handle

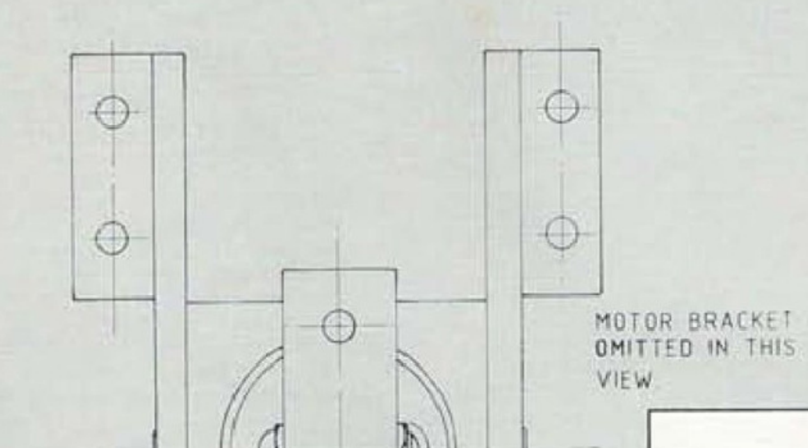
I needed to provide a means of weighting the saw frame and decided that the weight-carrying rod could also serve as a convenient lifting handle. Accordingly, a pair of 3 in. pieces of [illegible] in. square B.M.S. were prepared by drilling [illegible] in. diameter holes through them at one end and slotting the other end to fit over the 'h' frame; these were then held in position by cheese headed screws. Initially I had planned for just one weight to be used but found that the saw cut rather slowly, so I added another weight of the same dimensions which improved matters considerably. A 1[illegible] in. diameter plastic ball screwed to the end of the rod provided a comfortable handle.

Frame prop

One of the things which always irritated me when using a certain industrial hacksaw was the method by which the saw was supported before being released for the cut. This was by a huge ungainly prop which was controlled by a long rod and operated by the thumb. One had to take the not inconsiderable weight of the saw by the







What makes John Brittain's clever power hacksaw design even more attractive and satisfying to use is the provision of a dashpot arrangement to provide back-stroke relief for the blade. Diagrams on this page describe it.

Parts of the dashpot – a vital piece of the design.

A POWER HACKSAW

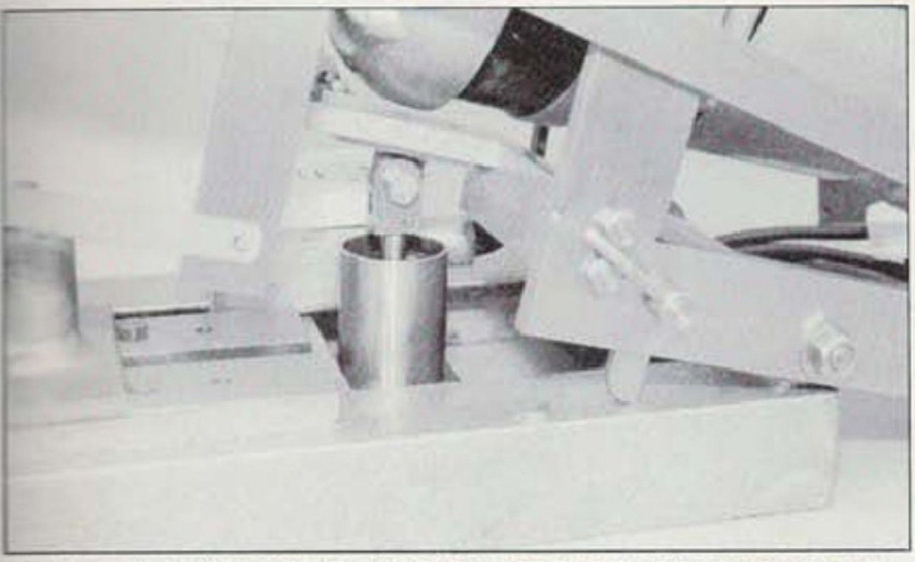


Illustration above shows how the dashpot provides support to the saw on its return stroke. Below, a rear view of the completed saw.

consisting of an oil cup and piston. As mentioned earlier, at the time of making the motor support bracket, I entertained fanciful notions of using it some way to hold such a device but space was so restricted that I kept dismissing the idea. Finally, however, the accumulation of thumps crystallised my thoughts and I hit upon the idea of suspending the cylinder on trunnions in the space beneath the bracket.

Rummaging around amongst my scrap, I produced a piece of 1[illegible] in. diameter brass tube which had certainly seen better days but which I thought could be pressed into service. After removing several dents by careful planishing on a piece of round bar, I cut the tube to length and skimmed both ends in the lathe. A flanged base was turned and silver soldered into one end of it, after which I turned my attention to the trunnion plate. This I made from a 2[illegible] in. length of 2 in. × [illegible] in. B.M.S., on each end of which I turned a [illegible] in. long by [illegible] in. diameter trunnion before boring its centre out for the

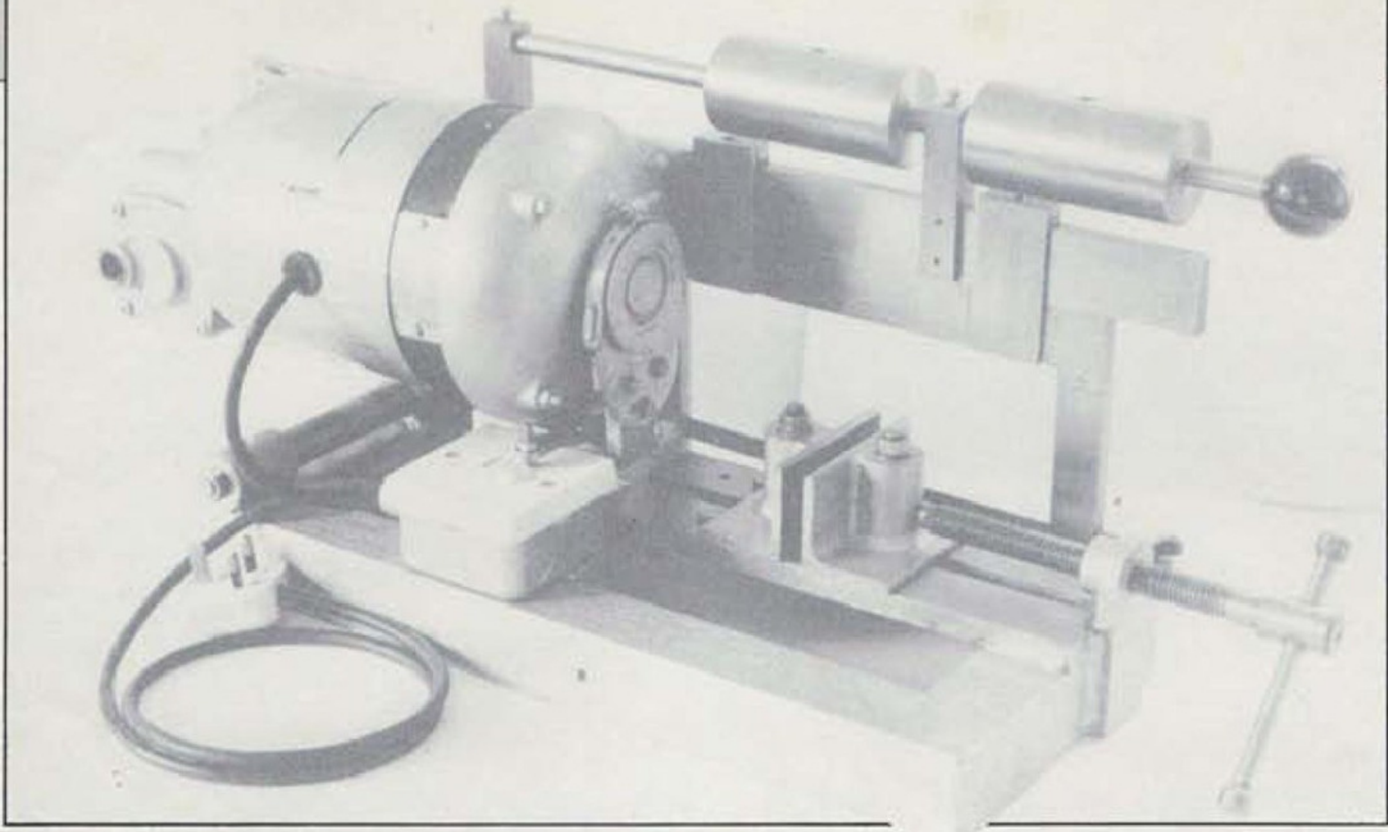
lifting handle, press the knob at the end of the rod and, at the same time, attempt to reach down and switch on the machine – altogether a somewhat daunting feat. I determined that my saw should not be so awkward to use as this and accordingly devised a simple prop which is self-actuating when the saw is lifted.

The prop piece was made from a 2 in. length of [illegible] in. × [illegible] in. B.M.S. shaped in the form of a quadrant at one end and drilled at the other end with a [illegible] in. diameter hole for a pivot pin. The pin was turned down from [illegible] in. diameter B.M.S. to [illegible] in. diameter and then reduced again to [illegible] in. diameter and threaded [illegible] in. B.S.F., the distance between the shoulders being a few thousandths of an inch greater than the thickness of the base side. The end of the pin was then cross-drilled for a tommy bar which was made a press fit in the hole. These components were assembled with a nut and washer so that when the saw is in the raised position, its weight is taken on the point of the prop's quadrant shaped end. Immediately the frame is lifted, the weight of the tommy bar causes the prop to pivot off its point and allows the saw to descend. The quadrant shape ensures that no jamming occurs during the descent.

Dashpot *(see Diagram 6)*

When first putting the saw to use, a rather undignified thump which accompanied the completion of each cut prompted me to look for some method of controlling the descent. A dashpot was the answer but where to hang it was the problem. A dashpot is a simple damper cylinder. The trunnion support brackets were fabricated from [illegible] in. × 3/16 in. and [illegible] in. × [illegible] in. B.M.S. pieces, silver soldered rather than welded together to ensure their squareness. These were then screwed to the underside of the base cross-member in a position where the cylinder would lie centrally beneath the motor bracket.

The cylinder was then slid down it its trunnion plate so as to ascertain its optimum position, allowing for tilting, before being sweat soldered. The piston was turned an easy fit in the cylinder and grooved to receive two 'O' rings; five [illegible] in. diameter oil holes were drilled through it and a sixth drilled and tapped 2 BA for the damping disc adjusting screw. The disc itself was parted off a little below 1/16 in thick, drilled and countersunk for it to be held loosely in position by a 2 BA



A view of the machine showing the simple but highly effective switching arrangement which uses an ordinary rocker switch.

countersunk screw. The piston rod fork end was made from three pieces and silver soldered together; this was then joined to the piston by a [illegible] in. diameter rod, shouldered and threaded at both ends, the distance between the shoulders being a mere [illegible] in.

The fork end anchor bracket was another easy silver soldering job which, on completion, was duly bolted to the fork end with the piston in the cylinder in order for me to ascertain the best position for fixing to the underside of the motor bracket. Space was so limited that I did this fixing with countersunk rather than hex. headed screws since the anchor bracker came perilously close to the top of the cylinder.

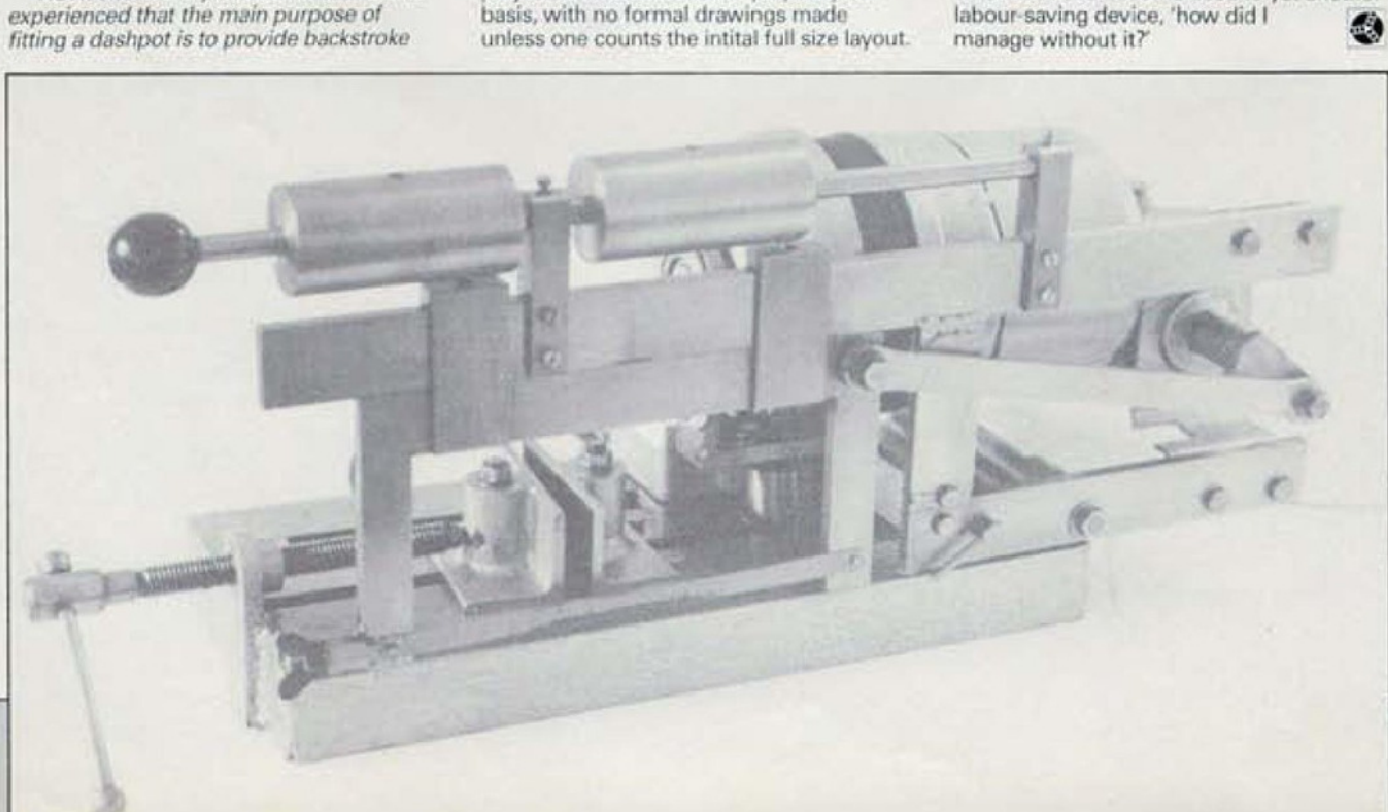
NB: It should be pointed out to the less experienced that the main purpose of fitting a dashpot is to provide backstroke relief for the blade. This was achieved more positively in my case by displacing the blade [illegible] in. out of parallel with the saw frame.

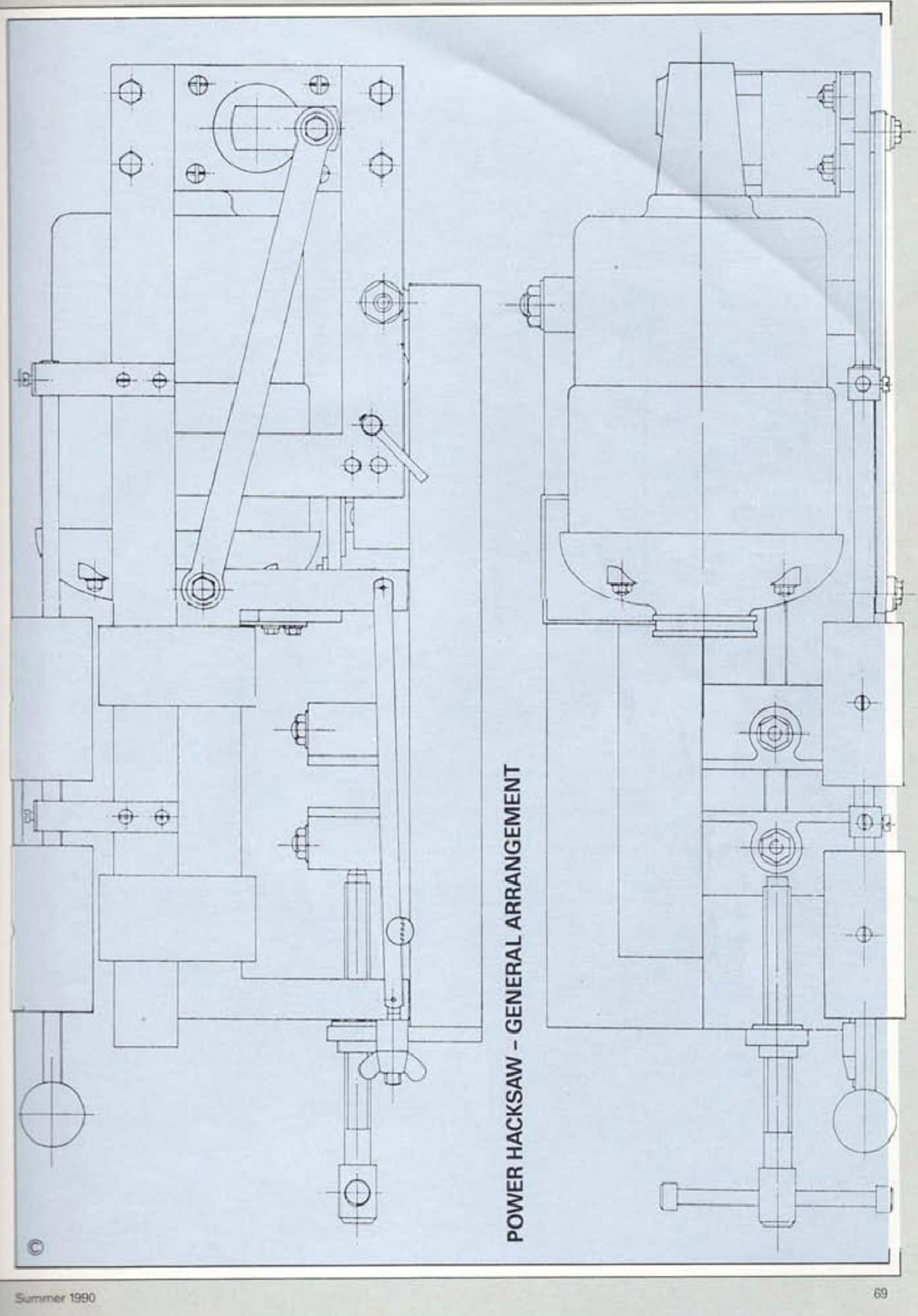
Stop switch

An automatic stop switch is, in my view, essential on a power hacksaw; so I purchased a standard 15 amp fused rocker switch and fixed it to the base on the opposite side from the 'H' frame. I was then able to screw a 'trigger' to the motor bracket which, when fitted with an adjusting screw and locknut, cut the motor at the appropriate moment.

As is obvious from the text, the whole project was executed on a 'play it by ear' basis, with no formal drawings made unless one counts the intital full size layout. Since I regarded the job as largely experimental, I expected to redesign and remake quite a number of items and was therefore reluctant to spend time on drawing out individual components, preferring to rely on freehand sketches and measurements taken from the actual work as its progressed. In spite of this, very little has needed to be altered and, so far, the saw has functioned with every satisfaction. As mentioned earlier, I decided to add an extra weight in order to facilitate faster cutting; I have also provided stops for the rear vice jaw since it seems somewhat reluctant to 'stay put' even when tightened firmly.

The machine has been in use for a considerable time and has become a most useful addition to the workshop (to date, the largest job it has tackled is cutting a piece of 2[illegible] in. square steel) – and I find myself wondering, as I'm sure we all do when we have become used to yet another labour-saving device, 'how did I manage without it?'





POWER HACKSAW – GENERAL ARRANGEMENT