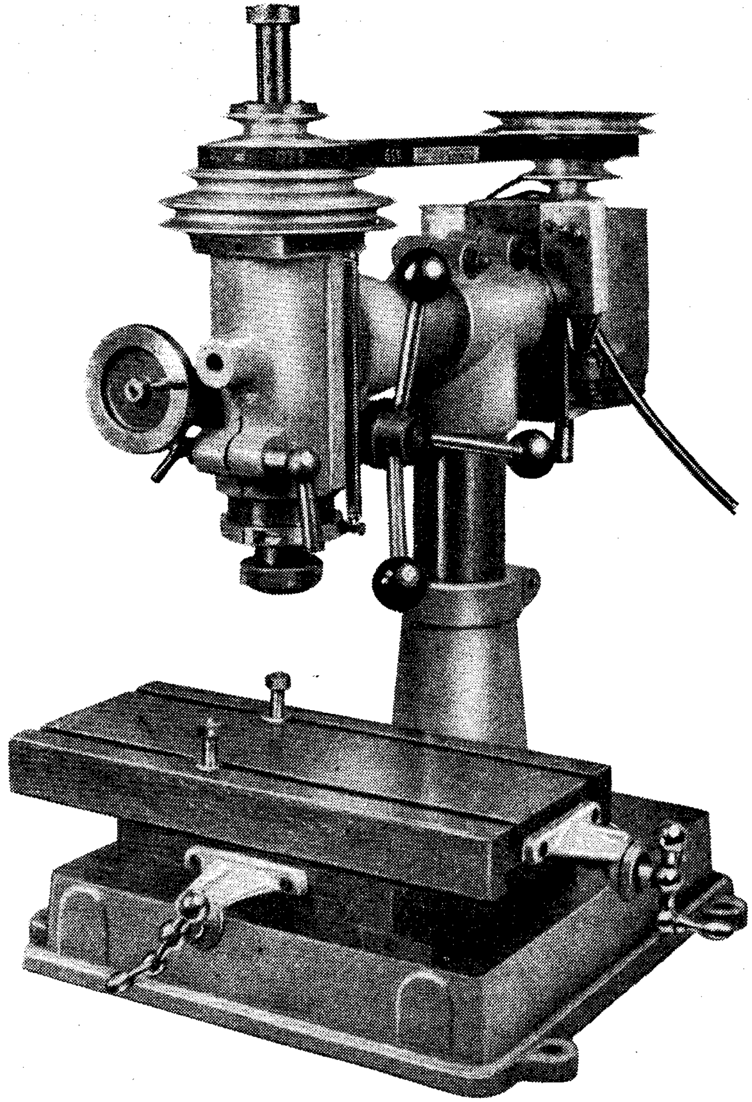
LIGHT VERTICAL MILLING MACHINE



Edgar T. Westbury introduces a project to which he has given attention over a period of three years. It can be built from the pull-out drawings in this issue

LIKE many model engineers, I like to improve my equipment. The milling machine illustrated here has occupied me for periods over three years. It is still in the experimental stage, but the results which I have obtained should make it of interest to others.

Generally speaking, the construction of complete machine tools is regarded as a very ambitious venture. If they are to be large enough to be of practical use, they are often beyond our machining capacity. Nevertheless, several fine examples of machine tools, including lathes, drilling machines, and grinders, have been designed and made by model engineers, usually with some outside assistance in the heavier machining operations.

While the value of lathe attachments is beyond question, nearly every model engineer at some time or other is faced with operations for which even the best of these devices are barely adequate, if adequate at all. In any event, a machine designed for its particular job will obviously have advantages over attachments which need to be specially set up and are often no more than an improvisation. Apart from drilling machines, several of which have been described in ME, the most useful and versatile machine to supplement the lathe in a small workshop is some form of milling device. This statement may perhaps be contested by readers who uphold the rival merits of shaping or planing machines. A great deal of course depends on the kind of work likely to be encountered. For operations involving purely straight-line motion of the cutting tools, shaping and planing machines have claims to superiority; but on the whole, machines which employ rotary cutting tools are the more versatile and efficient.

I made the decision to build a small milling machine after carefully considering all the problems, work involved in relation to the advantages likely to be obtained, and whether sufficient use would be made of it to justify its existence. The cost of building the machine, compared with that of any ready-made one, new or second-hand, was another point to be taken into account. But there is not a very wide choice in small milling machines; most of the new ones cost more than the amateur can afford, and second-hand bargains are few.

Some of the many types of milling machine are designed for specialised work such as die-sinking, gearcutting and key-seating. For general engineering, the main choice rests between two, those with horizontal and vertical spindles. Either will deal with a wide range of work, but has its own limitations. For many years the horizontal was the more popular, but in modern practice, machines with vertical or angular spindles are increasingly employed. Some designs in which the angle of the spindle can be varied in one or more planes have been loosely described as "universal" milling machines; according to the standard text-books, this vastly overworked adjective is properly applicable only to horizontal millers equipped with a swivelling table geared for cutting spirals of various pitch or lead angles. But there is no doubt that a facility for varying the spindle angle increases the versatility of the machine.

There have been no new basic principles in the design of machine tools since the days of Holtzapffel, who defined almost every possible method of shaping material, or " mechanical manipulation " as he called it, well over a hundred years ago. Modern tools follow the same principles as their predecessors, but are vastly improved in detail and more robust in structure, with provision for greater power, speed and range of speed and feed control. A claim that any design is original, can be true only to a very limited extent, and is open to challenge on the grounds that " there is nothing new under the sun." In adopting the particular features of this machine, my major aim was to obtain the utmost utility with parts which-mainly at least-could be machined by our limited equipment.

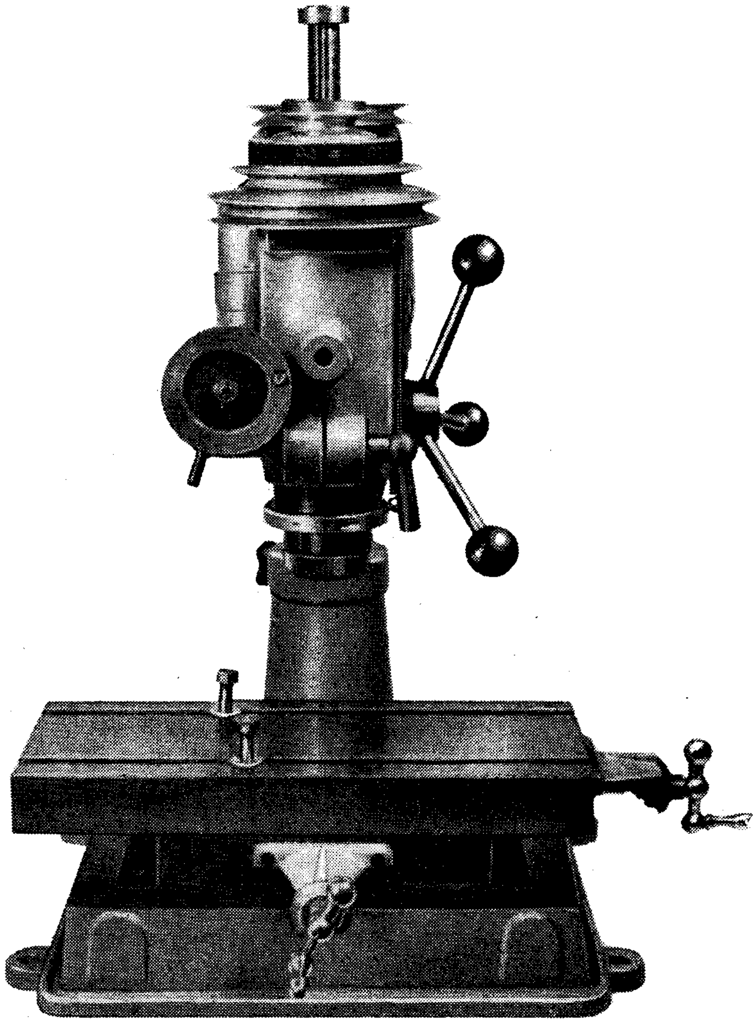
Ideal size

An eminent biologist once wrote a monograph on " The importance of being the right size," in which he pointed out that a flea enlarged to the size of an elephant, or an eagle reduced to the size of a gnat, would be quite impracticable. Similarly, there is a definite relation between design and magnitude in machines, and I gave a good deal of thought to all its aspects. The preliminary sketches of the design showed that the problems of construction increased greatly as sixes were enlarged, and I was strongly tempted to keep the main parts as small as possible. All the parts of a small machine of this type, taking up to No 1 Morse shank cutters, could be machined on my ML7 3½in. lathe, except for the base and compound slide. It would be quite a useful machine too, within its dimensional capacity; but this would not be much greater than that of some of the attachments which I already had and intended to supersede.

The use of steel tubes for vertical and horizontal adjustable members to support the milling head provides for radial swing and extension, and for swivelling movement of the spindle. Machines with circular slides have often been criticised, mainly on the grounds of poor torque resistance and difilculty in maintaining alignments. These tubes, however, are not sliding members in the accepted sense; they are not used for feed or traversing movements, but are firmly clamped while the machine is in operation. The only circular sliding member is the spindle bearing housing, or quill, and this is not subjected to any appreciable torque load or tendency to misalignment. On the other hand, it provides the simplest and most sensitive vertical feed, and does away with the need for a relatively heavy slide to carry the entire spindle head.

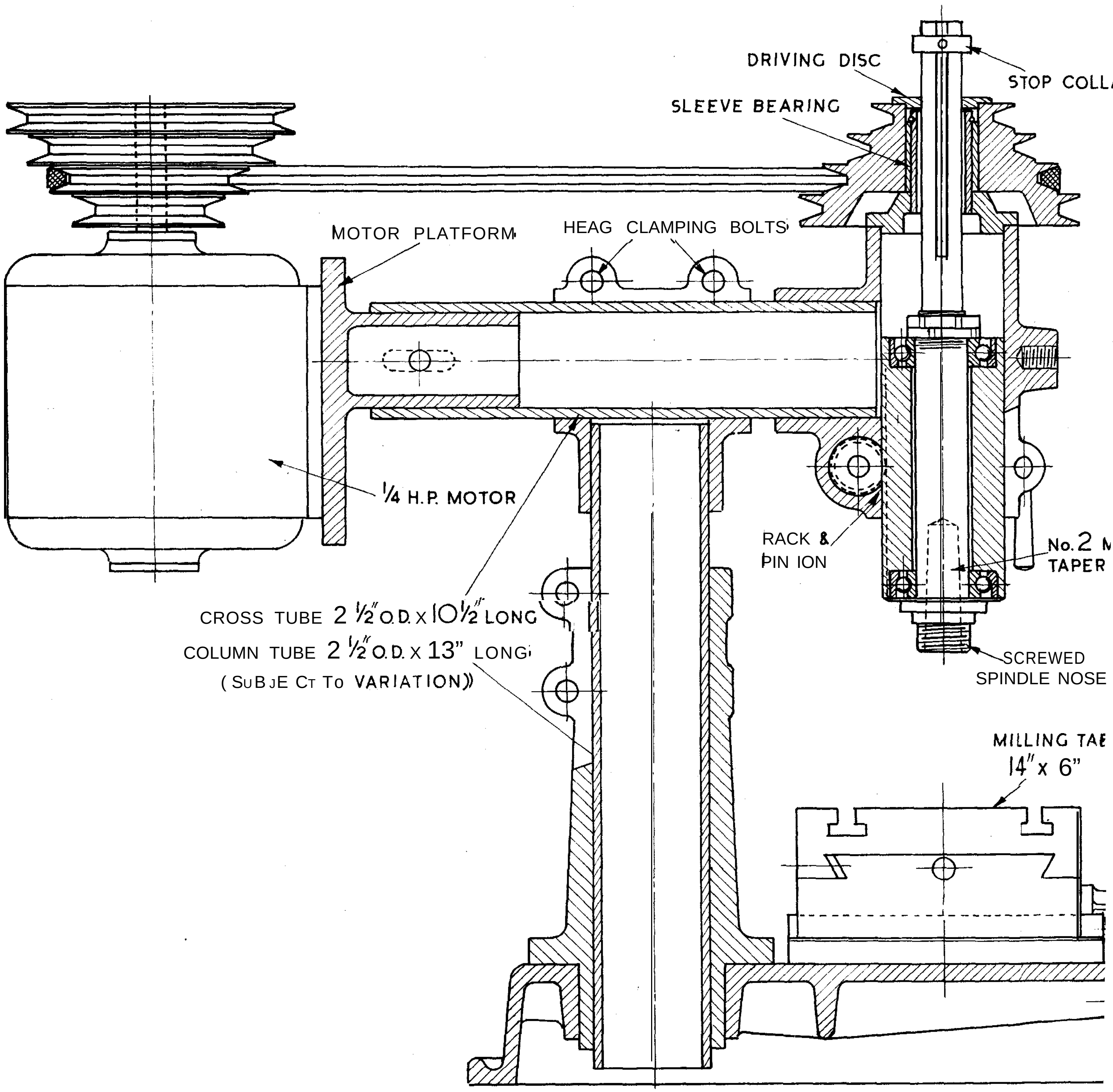
In any kind of milling machine, the work table needs to be rigidly supported, and to be adequate in length and breadth for the largest work. Longitudinal and cross traversing movements also need to be ample, with a good bearing area. All this adds up to a pretty large and heavy compound slide. When the slide is supported by a vertical sliding knee as in orthodox milling machines, this in turn must be proportionate in sire, and well braced to prevent possible sag of the table. But by eliminating the need for vertical adjustment of the table, the slide can be laid directly on a plain base, to provide rigid support with no further complication. This is not an argument against the sliding-knee machine, which is well suited to general purposes; but the form of table support, and other features of this machine, have advantages from the aspect of simple construction.

The vertical movement of the quill, by a rack and pinion, is similar to that of a sensitive drilling machine; in fact, the

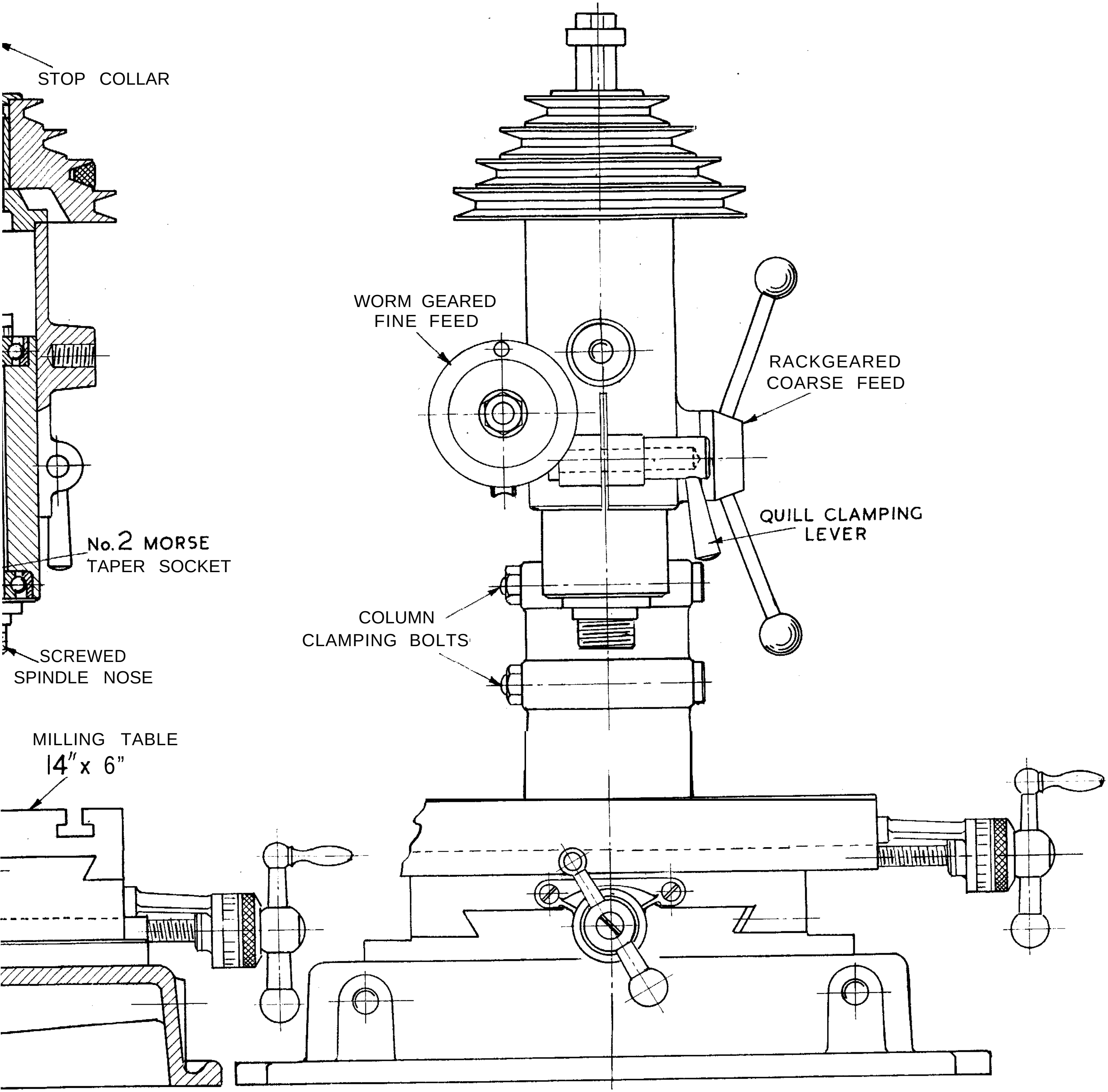


machine can be used efficiently in this capacity, with feed applied by a lever or windlass to the pinion shaft. For milling, which requires a more precise graded vertical feed movement, a worm wheel is fitted to the pinion shaft; a worm giving a high ratio of reduction can be engaged with it. Spring return is provided for the quill; at first I used a torsion spring on the pinion shaft, similar to that of the orthodox drilling machine, but I have changed it to a tension spring acting on the quill directly. The advantage of this arrangement is that it acts as an anti-backlash device, being always loaded in the upward direction against the weight of the quill and spindle assembly. The cutter or drill is thus prevented from snatching when brought into engagement or breaking through a hole, as often happens through lost motion in the feed gear.

To be continued

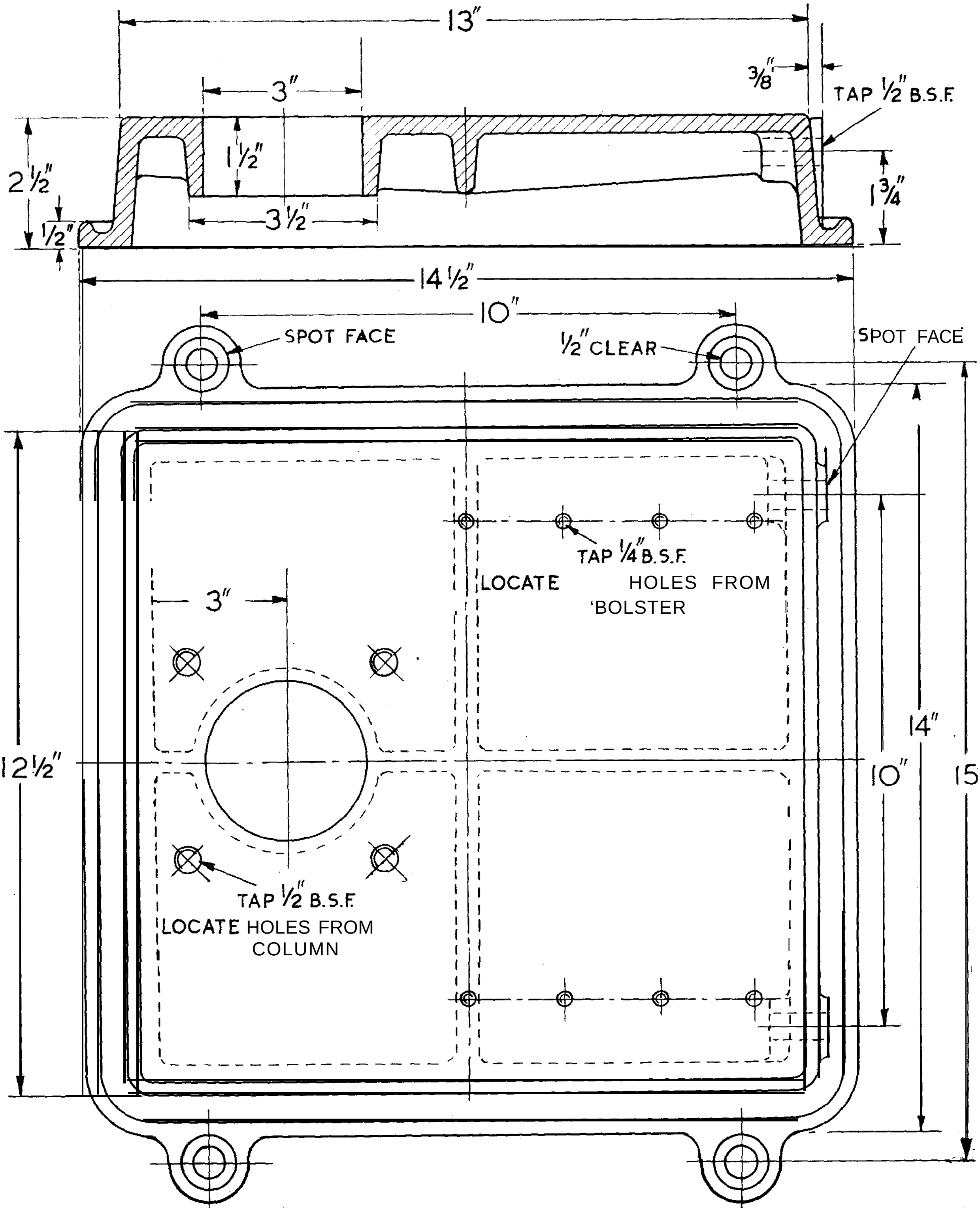


LIGHT MILLING 8 DRILLING MACHINE ½" CAP

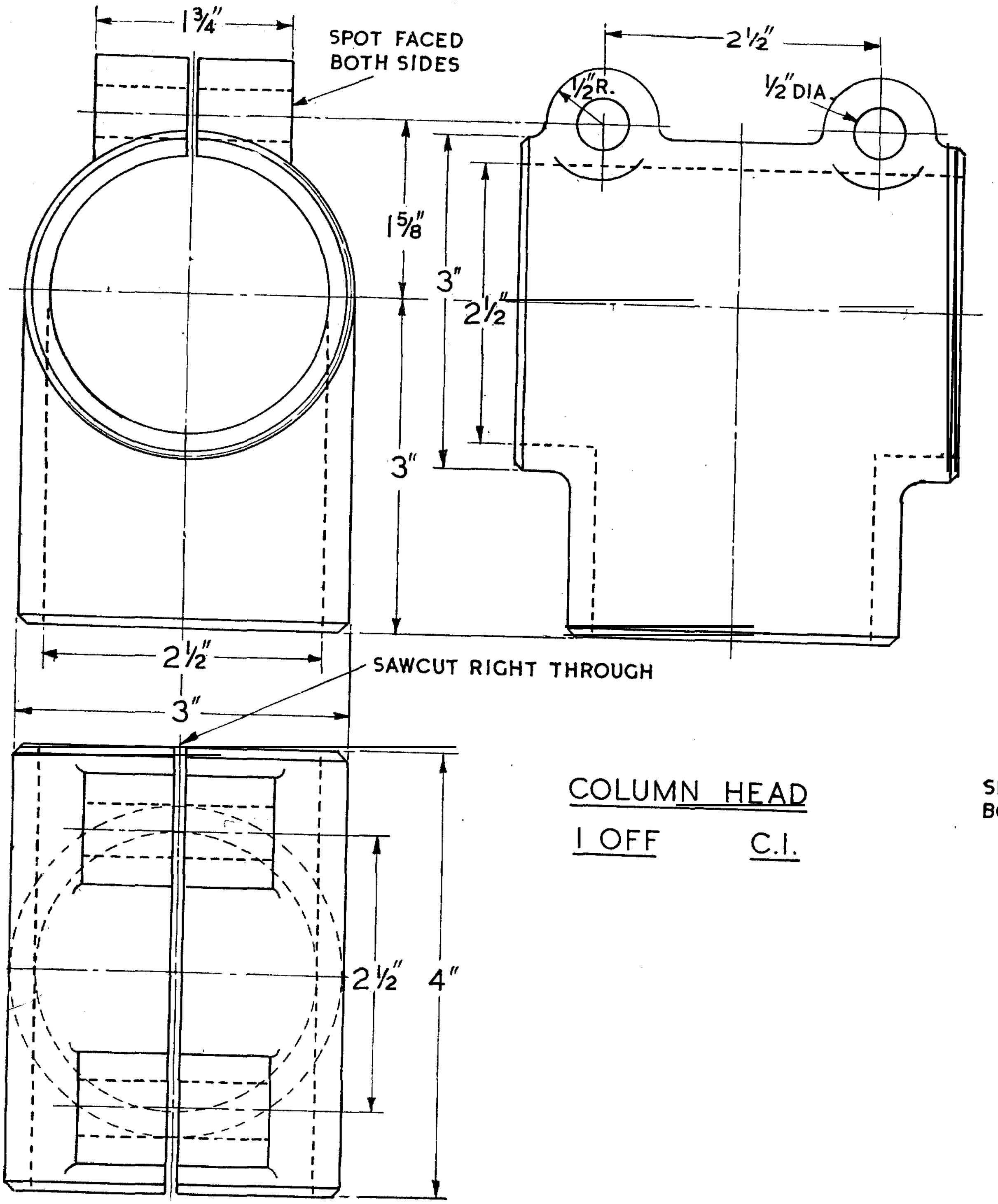


½" CAPACITY

DESIGNED BY EDGAR T. WESTBU RY

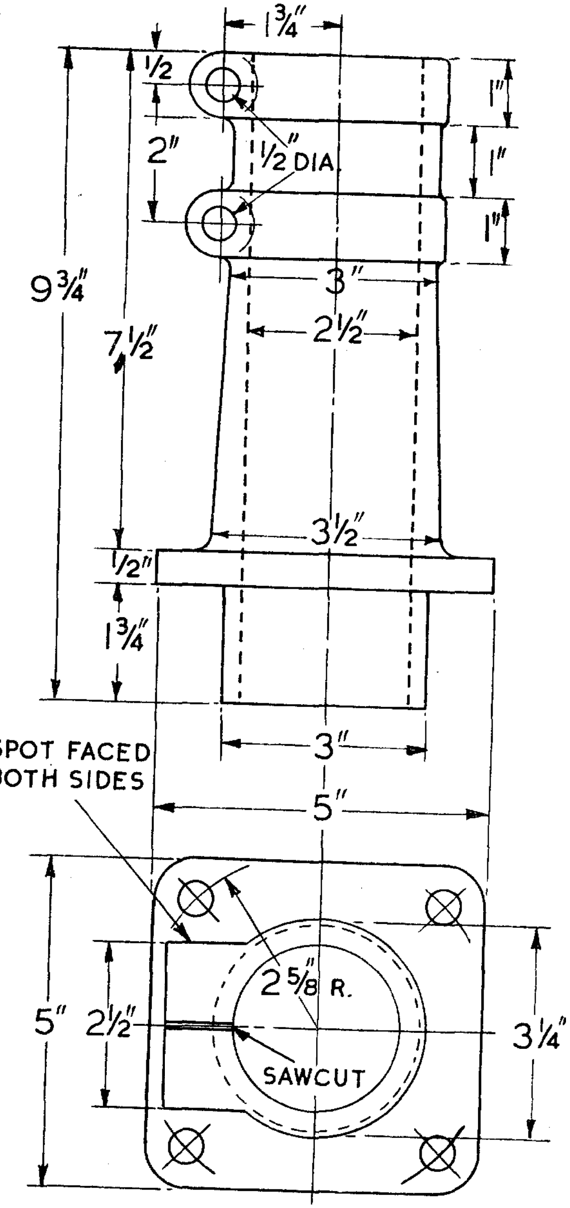


BASEPLATE 1 OFF C.I. OR L.A.

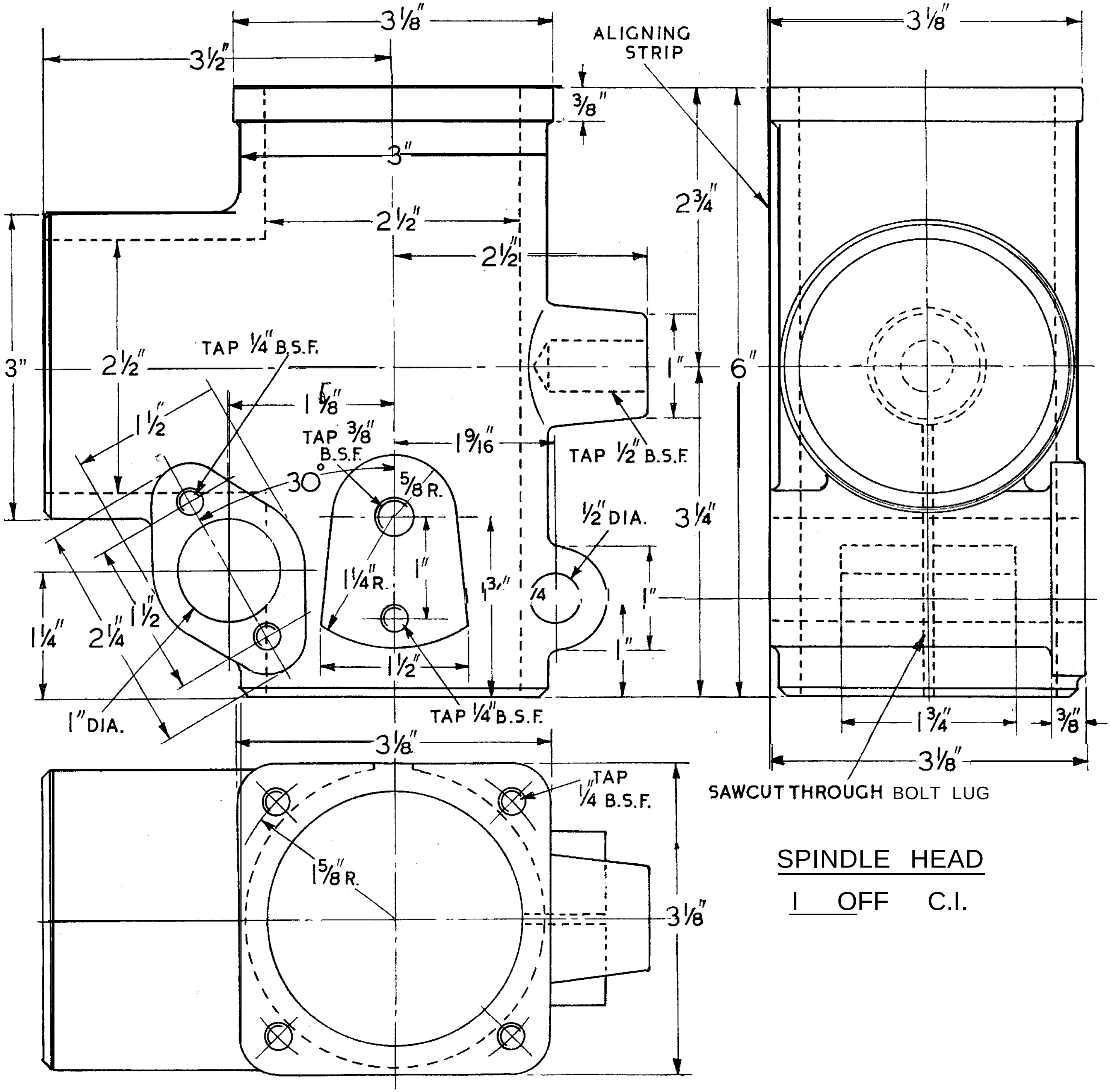


COLUMN HEAD

1 OFF C.I.



COLUMN 1 OFF C.I.



SPINDLE HEAD

1 OFF C.I.