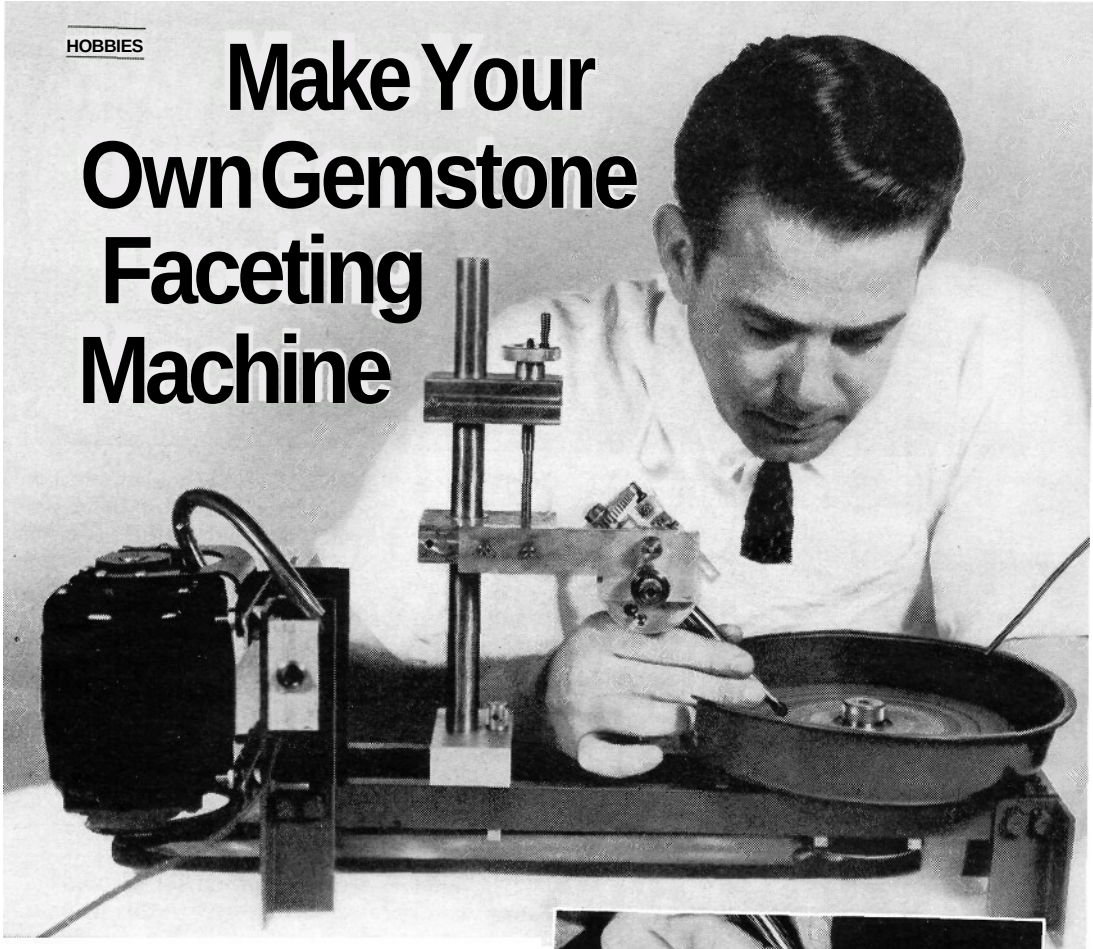
Make Your Own Gemstone Faceting Machine



The art of lapidary—polishing stones to best display their qualities—is an ancient one. With this motor-driven machine, you can do it effortlessly.

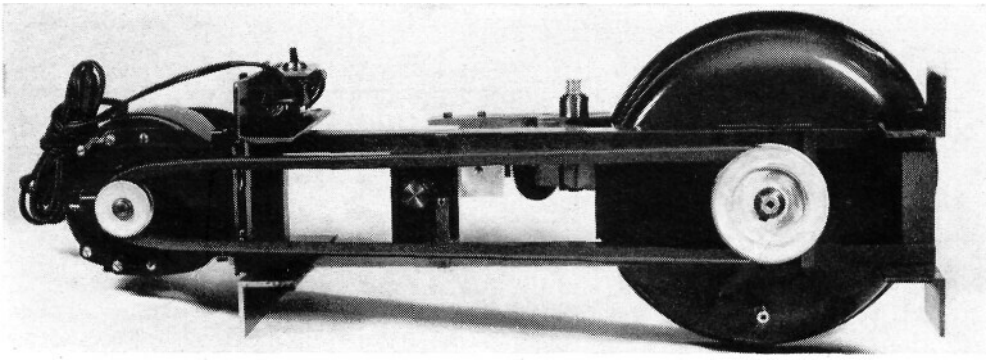
By MOODIE E. BRAUN JR.

LAP PLATE can be of copper, tin or plastic, depending on faceting step. Pie tin acts as splash guard

UNLESS YOU HAVE SEEN someone cutting and polishing a stone, or tried it yourself, you'll be amazed at the satisfaction you get from bringing out the inherent beauty of a stone. The art of lapidary has fascinated man for centuries and many methods have been devised for doing it.

Nowadays, all you need is a faceting machine like the shop-built version described here plus a set of cutting and polishing laps, polishing powders, a selection of dops (tools) for holding stones, a dop transfer kit *and* the patience to follow step-by-step instructions (These can be found in any good gem-faceting book. One that I recommend is *Gemcraft* by LeLande Quick and Hugh Leiper.

Though a detailed explanation of lapidary methods is beyond the scope of this



BOTTOM VIEW of faceting machine shows relationship of work end of rig to the motor. Lap plate itself is commercially available item and usually has a 1/2-in. mounting hole which is placed over the shaft

article, a description of some basic steps is necessary in order to understand the functions of the various machine components. For example, with a round, brilliant cut stone the first stage is preparation of the preform. This is simply the process of grinding the stone to a general shape to permit easier and more accurate finishing. With a round brilliant, the first preform shaping is to grind and polish the top or table by hand, using the lap plate and holding the stone with your fingers. The next step is to grind the outer circumference of the top, to the largest circular diameter possible. The final step is to shape the stone so that it resembles a turnip.

The stone is then mounted on a cone-shaped dop using a transfer jig. The transfer jig is a simple, inexpensive accessory which enables a stone to be placed accurately on a dop or to be transferred from one dop to another. (Use and selection of dops is described in the book mentioned on the preceding page). The dop is then mounted in the machine's index head and the facets are ground and polished according to the shape and type of stone.

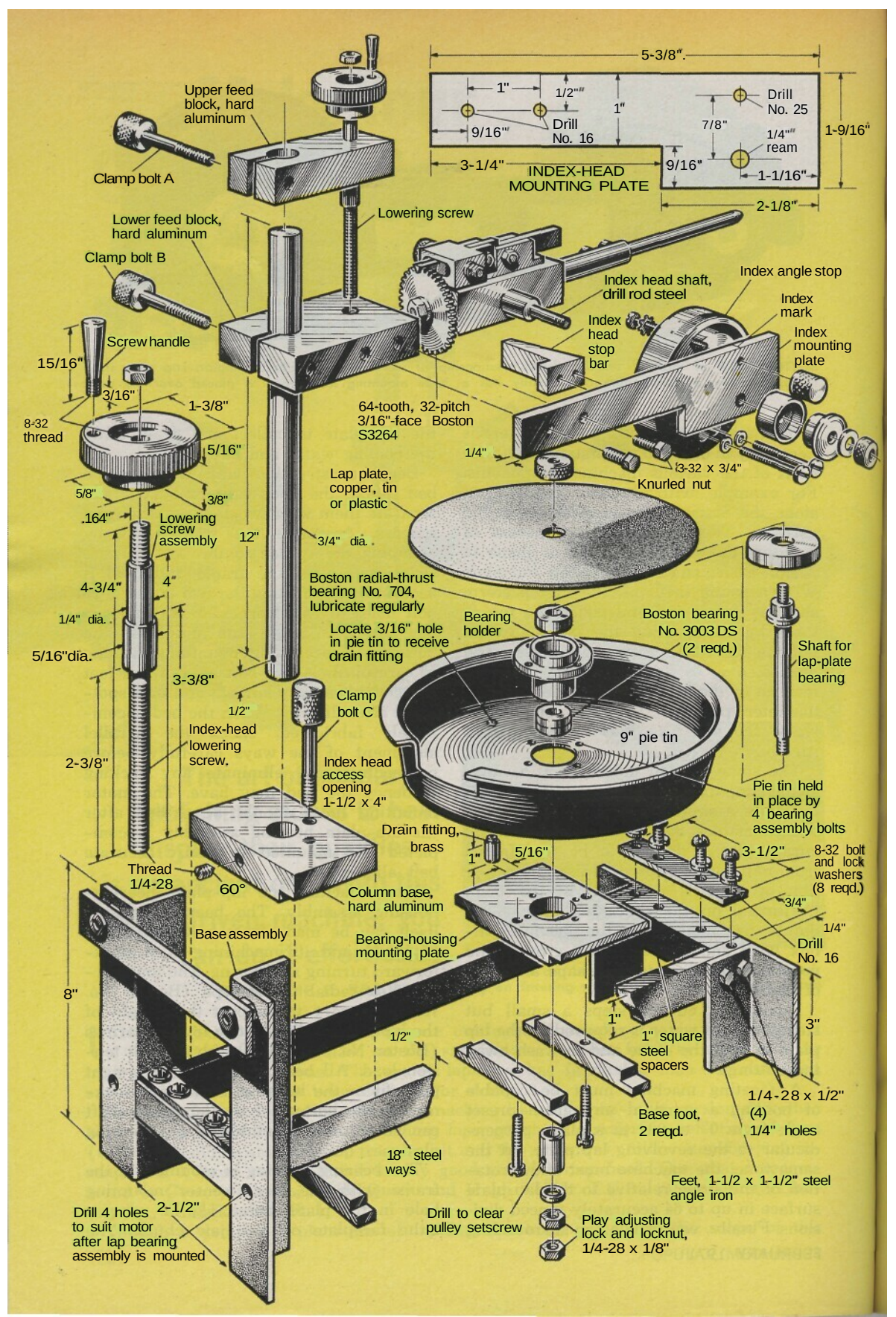
During all cutting steps a small but steady drip of water is required on the lap plate to cool the stone and to wash away the cuttings.

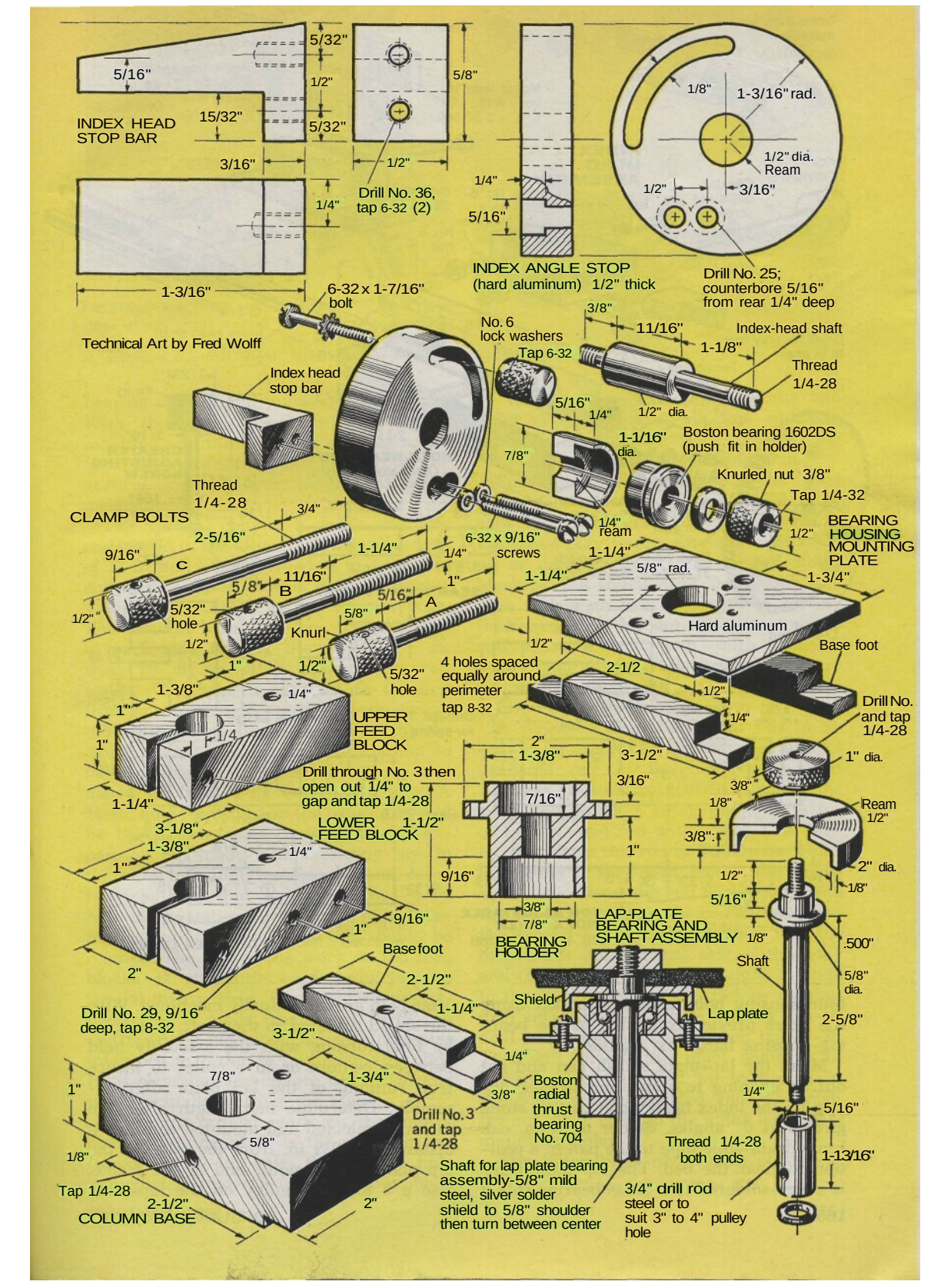
A faceting machine must be capable of holding a stone at any given preset angle from 0° to 90° in a plane perpendicular to the revolving lap plate. At the same time, the machine must allow rotation of the stone relative to the lap plate surface in up to 64 accurately spaced divisions. Finally you need a pan surrounding the lap plate to collect and drain away the cooling water and cuttings.

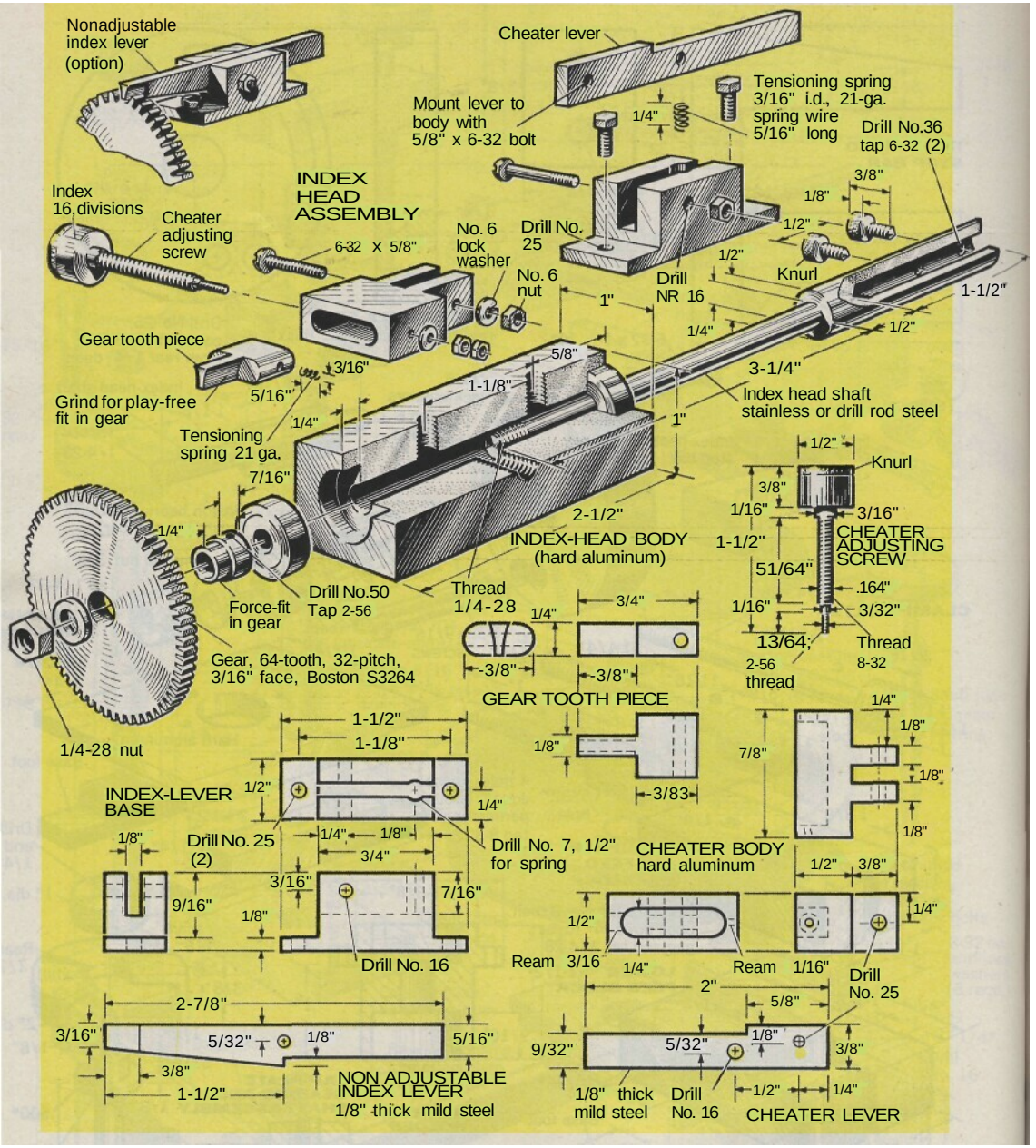
Begin construction with the machine bed. Make the bed ways as shown and separate them with two l-in.-square steel spacers. Assemble the frame first by clamping the spacer to the ways. These strips will align the frame and hold it accurately for drilling the two large 1/4-28 bolt holes in each corner. Make the four bed feet from angle iron and finish the bottom ends accurately by milling, turning or careful filing. The bolt holes in the feet should be carefully laid out and then spot-faced after drilling. When the bed is completely fabricated, check the parallel alignment of the ways carefully before proceeding, and eliminate any rocking tendency the bed may have. The motor mounting holes should be drilled after the lap-plate bearing assembly is completed and mounted to insure accurate belt alignment.

Next, machine the lap-plate, bearing-housing assembly. The bearing housing itself can be made from hard aluminum or brass, and its machining is straightforward turning and boring. The top bearing is a radial thrust-type (Boston No. 704) necessary to support the weight of the lap plate while the two lower bearings (Boston No. 3003DS) absorb the belt tension load. All bearings should be a tight push-fit in the housing. A nut and locknut on the bottom of the lap-plate shaft can be adjusted to eliminate any bearing play.

The bearing housing is mounted to the frame with the large center mounting hole in the plate, bored 11/4in. using a lathe faceplate or four-jaw chuck. The

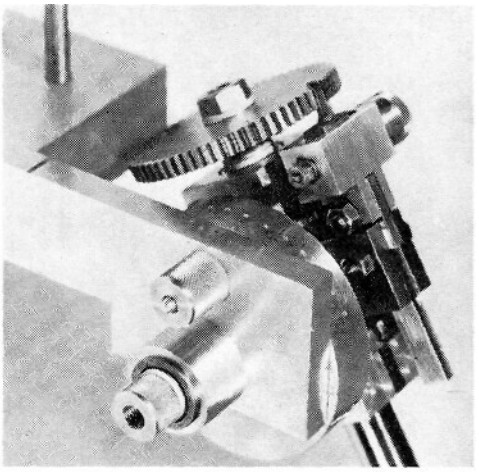

5-3/8".
1"
1/2"
1"
Drill No. 25
7/8"
1-9/16"
9/16"
Drill No. 16
1/4" ream
3-1/4"
INDEX-HEAD MOUNTING PLATE
9/16"
1-1/16"
2-1/8"
Upper feed block, hard aluminum
Clamp bolt A
Lower feed block, hard aluminum
Lowering screw
Clamp bolt B
Index angle stop
Index head shaft, drill rod steel
Index mark
Index head stop bar
Index mounting plate
Screw handle
15/16"
3/16"
1-3/8"
8-32 thread
5/16"
5/8"
3/8"
64-tooth, 32-pitch 3/16"-face Boston S3264
1/4"
3-32 x 3/4"
Knurled nut
Lap plate, copper, tin or plastic
.164"
Lowering screw assembly
12"
3/4" dia.
4-3/4"
4"
1/4" dia.
5/16"dia.
Boston radial-thrust bearing No. 704, lubricate regularly
Bearing holder
Boston bearing No. 3003 DS (2 reqd.)
Locate 3/16" hole in pie tin to receive drain fitting
Shaft for lap-plate bearing
3-3/8"
1/2"
Clamp bolt C
9" pie tin
Index-head lowering screw.
2-3/8"
Index head access opening 1-1/2 x 4"
Pie tin held in place by 4 bearing assembly bolts
Drain fitting, brass
1"
5/16"
3-1/2"
8-32 bolt and lock washers (8 reqd.)
Thread 1/4-28
60°
Column base, hard aluminum
3/4"
1/4"
Base assembly
Bearing-housing mounting plate
Drill No. 16
8"
1"
3"
1/2"
1" square steel spacers
1/4-28 x 1/2" (4) 1/4" holes
Base foot, 2 reqd.
18" steel ways
Feet, 1-1/2 x 1-1/2" steel angle iron
2-1/2"
Drill 4 holes to suit motor after lap bearing assembly is mounted
Drill to clear pulley setscrew
Play adjusting lock and locknut, 1/4-28 x 1/8"

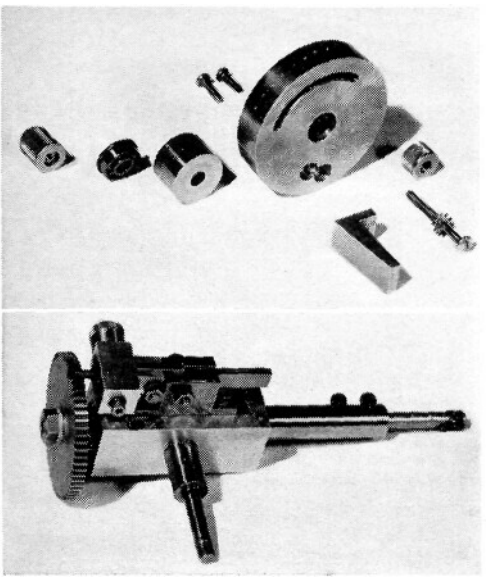

INDEX HEAD STOP BAR
5/16"
5/32"
1/2"
15/32"
5/32"
3/16"
1/2"
5/8"
1/4"
Drill No. 36, tap 6-32 (2)
1-3/16"
INDEX ANGLE STOP (hard aluminum) 1/2" thick
1/4"
5/16"
1/8"
1-3/16" rad.
1/2" dia. Ream
1/2"
3/16"
Drill No. 25; counterbore 5/16" from rear 1/4" deep
6-32 x 1-7/16" bolt
Technical Art by Fred Wolff
No. 6 lock washers
Tap 6-32
Index head stop bar
3/8"
11/16"
1-1/8"
Index-head shaft
Thread 1/4-28
5/16"
1/4"
1/2" dia.
1-1/16" dia.
Boston bearing 1602DS (push fit in holder)
7/8"
Knurled nut 3/8"
Tap 1/4-32
1/4" ream
1/2"
BEARING HOUSING MOUNTING PLATE
Thread 1/4-28
CLAMP BOLTS
3/4"
2-5/16"
9/16"
C
1-1/4"
1/4"
6-32 x 9/16" screws
1-1/4"
5/8"
11/16"
B
1"
5/16"
A
5/32" hole
1/2"
Knurl
5/8"
1/2"
1"
1/2"
5/32" hole
1-1/4"
5/8" rad.
1-3/4"
Hard aluminum
Base foot
4 holes spaced equally around perimeter tap 8-32
2-1/2
1/2"
1/4"
Drill No. and tap 1/4-28
1-3/8"
1/4"
1"
1"
UPPER FEED BLOCK
1/4
1-1/4"
2"
1-3/8"
3-1/2"
3/16"
1" dia.
3/8"
Drill through No. 3 then open out 1/4" to gap and tap 1/4-28
7/16"
1/8"
Ream 1/2"
LOWER FEED BLOCK
1-1/2"
3-1/8"
1-3/8"
1/4"
1"
1"
9/16"
3/8":
2" dia.
1/2"
1/8"
5/16"
9/16"
3/8"
7/8"
BEARING HOLDER
LAP-PLATE BEARING AND SHAFT ASSEMBLY
1/8"
.500"
Shaft
5/8" dia.
Base foot
2-1/2"
1-1/4"
Shield
Lap plate
2-5/8"
3-1/2"
1/4"
Drill No. 29, 9/16" deep, tap 8-32
1-3/4"
3/8"
Boston radial thrust bearing No. 704
1/4"
5/16"
7/8"
1"
Drill No. 3 and tap 1/4-28
5/8"
Thread 1/4-28 both ends
1-13/16"
1/8"
Tap 1/4-28
2-1/2"
COLUMN BASE
2"
Shaft for lap plate bearing assembly-5/8" mild steel, silver solder shield to 5/8" shoulder then turn between center
3/4" drill rod steel or to suit 3" to 4" pulley hole



four housing bolt holes are drilled using the holes previously drilled in the bearing-housing flange as a guide.

Make the lap-plate splash pan and cut out an opening to allow unrestricted access by the index head when cutting stone girdles at 0° angles. Solder a 5/16-in. o.d. brass drain-tube pipe to the pan in a position to clear the bed. The lap-plate shaft is silver-soldered to a brass bearing shield after both are individually machined. With the shield soldered to the shaft, true it up by final turning with the assembly held between centers or in a collet to insure true running of the lap plate after assembly. Determine belt length after the motor is selected and mounted to allow a distance of 10¼ in. from the edge of the lap plate to the motor end of the frame. Use a 3 to 4-in. pulley on the lap-plate





FACETING MACHINE must be capable of holding a stone at any angle from 0° to 90° from perpendicular. Text tells which bearings to use and where to get them. Cheater (right) is advised as addition

bearing and 1½-in. pulley on the motor. With the frame assembled, the motor mounted and the lap plate running satisfactorily, construction can proceed on the vertical column and height adjusting mechanism.

The vertical column is made with the ends faced in the lathe to an overall length of 12 in. and a hole drilled ½ in. from one end with a ¼-in. center drill to receive a locking setscrew in the column base. The column base has deep insets milled in each side leaving the center 2½ in. wide (to fit smoothly between the bed ways). The base is clamped to the bed from one edge by a knurled clamp screw.

The two fine-feed mechanism blocks which operate on the vertical column to raise and lower the index head are also machined from 1-in. hard aluminum. A ¾-in. hole for fitting on the column should be bored or reamed ¾ in., then an expansion cut made with a slitting saw in the lathe or milling machine, or cut carefully with a thin hacksaw. The ¼-in. hole in the upper block serves as a bearing for the lowering screw and should be reamed. The rest of the work on the feed blocks is straightforward requiring no special instructions. The fine-feed adjusting screw is made from 5/16-in. drill rod and must be machined to close diameter tolerance in order to minimize any play. *Both clamping screws are always locked* while actually cutting the stone.

The only critical work on the index-head mounting plate is the distance between the ¼-in. hole, the No. 25 hole immediately above it and the index mark on the top edge. The center of the two holes *must* be exactly in line with the index mark and at a right angle to the horizontal axis of the mounting plate.

The index-head assembly is the heart of the faceting machine and considerable care should be taken in constructing it. Excessive play in any direction will show up as inaccuracies in the finished stone. Machine the index-head body and face each end to an overall length of 2½ in., then accurately lay out the center on one end. Make a deep "pop" with a center punch, and adjust to run truly in a four-jaw chuck. Start with a center hole, then drill all the way through 5/16 in.

A recess is then bored out 11/16 in. in dia. by ¼ in. deep to hold (with a tight push-fit) one of the index-head shaft bearings (Boston No. 160DS). Remove the body and chuck a scrap piece of ½-in., or larger, steel rod with about 2 in. protruding. Turn this rod to a diameter which fits tightly in the 5/16-in. hole in the index-head body. Twist the end of the body with the bored recess onto the rod and machine the second bearing recess. Mark out the pivot shaft hole on one side of the body and drill with a No. 3 drill right through to the 5/16-in. center hole. Before tapping, drill into the No. 3 hole with a 15/64-in. drill to a depth of 3/32 in., then tap 14-28. This will enable the pivot shaft to be locked when tightened up to the ¼-in. shoulder of the threaded end. To finish, lay out, drill, and tap the index lever base mounting holes.

The index-head pivot shaft should be

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GEMSTONE FACETING MACHINE

(Continued from page 161)

machined with accuracy with both ends reduced to 1/4 in. diameter for 3/8 in. and 1 1/8-in. lengths. Tighten the shorter end into the index head body. The index-head dop shaft also requires careful machining to insure a play-free fit in the bearings. This shaft should be machined with one end turned to 1/4-in. dia. for a length of 3 1/4 in. and thread the tip 1/4-28 for 5/16- in. Then drill a 15/64-in. hole 1 1/4-in. deep in the 1/2-in. dia. end and follow by reaming 1/4 in. Use a tail-stock "V" drill pad and drill two No. 36 holes in the 1/2-in. dia. part of the shaft 1/8 and % in. respectively from the end. Drill right through into the 1/4-in. reamed hole and tap 6-32. Two 3/8-in. 6-32 knurled screws with 45° tips are machined to engage the groove found in dop shafts.

The index gear I selected is a Boston No. S3264, 64-tooth, 32-pitch, 3/16-in.-face steel gear with a 3/8-in. hole. Since the majority of stones are cut in multiples of 8 facets, this 64-tooth gear will permit indexing a wide selection of facets.

The index lever and base is machined using a lathe milling attachment or milling machine. Any vertical play of the lever is not important but there should be *no side play.* Also, the gear end of the lever should be carefully ground for a play-free fit in the gear teeth. A simple, non-adjustable index lever could be used but experience proves that an adjustable lever (called a cheater) is useful. As with most mechanical devices, things are never absolutely perfect and a cheater enables minute adjustments to be made. Its construction is fairly simple. The spring-loaded gear-tooth piece eliminates play, and, as with the simple lever, careful grinding is required for a close fit with the gear teeth to eliminate play and to bring the lever level when it's engaged.

In order to eliminate lateral play of the index head, compensate for pivot shaft wear and to adjust index head lowering tension, the index head which pivots in the index-head mounting plate is also supported by a friction adjusting mechanism. This device consists of a brass bearing holder which serves as an additional 1/4-in. bearing surface for the index head-pivot shaft and holder for a friction adjusting ball bearing. The purpose of the ball bearing is to provide a friction-free surface which will allow the adjusting nut to be tightened to any setting without being loosened by shaft rotation.

The final major component to make is the angle stop. The rough shape is cut by hacksaw, and after you mark the center and scribe to interesting lines 90° apart, a 1/2-in. hole is reamed in the center of the rough piece. The stop is then mounted on a mandrel and turned to a 23/8-in. dia.

To finish, mount a switch on one of the legs, connect the motor in series with the switch and a power cord, arrange for a water supply, and cut a 2-in. length of 5/32-in. drill-rod steel for a clamping screw tightening lever. Finally, paint all non-working steel surfaces on the bed with two coats of rust-resistant enamel. * * *