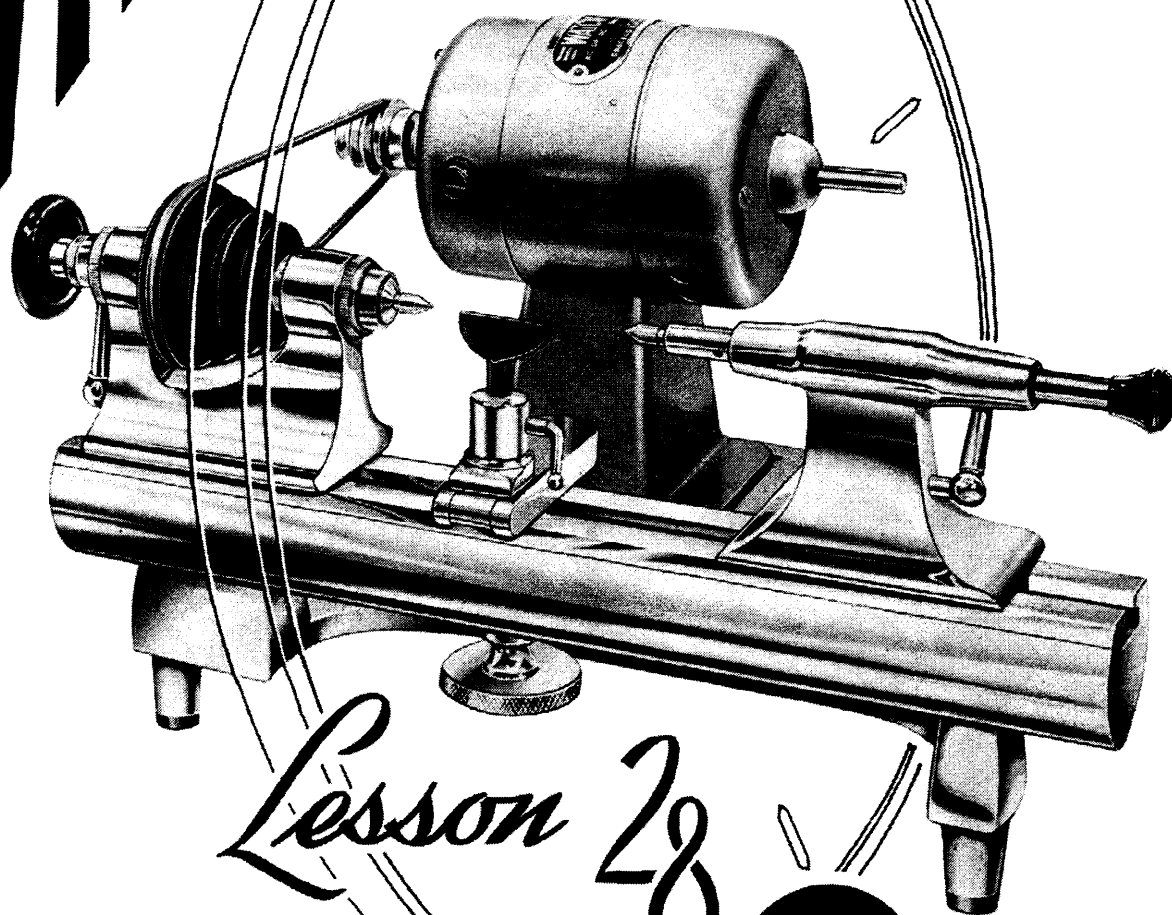


Master WATCHMAKING



Lesson 28

THE
LATHE

CHICAGO SCHOOL OF WATCHMAKING

Founded 1908 by THOMAS B. SWEAZEY

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SEC. 475 — The Watchmaker's Lathe

In the lessons so far you have been shown some of the practical work of watch repairing without the use of that very important part of the expert's equipment—the watchmaker's lathe.

Before proceeding with the more advanced problems in watch repairing, it is essential that you be able to cut square shoulders, polish pivots, reset jewels, turn down jewel settings, fit balance staffs and pinions, and do numerous other jobs that can only be accomplished on an accurately made lathe of proper size and with sufficient equipment.

Very few people outside the profession know the part which this tool plays in the delicate work of creating the timepieces of today. In its present perfection, the modern lathe combines a degree of accuracy and ease of operation undreamed of by the old masters who toiled long and laboriously to accomplish what today's Master Watchmaker is able to do in a few moments with the aid of his ever-ready lathe. Many do not realize that with a first class lathe and its attachments such as should be found on every Master Watchmaker's bench, the expert workman is able to make a complete watch capable of keeping the most accurate time. While the modern lathe will accomplish such work in skilled hands, the

mastery of it cannot be acquired by merely studying from any text book. However, as in any other watchmaking projects, only by constant and consistent practice can the beginner hope to become expert.

Through abuse, a lathe may be easily thrown out of its fine adjustments or out of true as to be practically worthless for the fine work for which it is intended. For this reason, it is best for the beginner to secure a new lathe and attachments and thus have the pleasure of working upon one that is capable of doing the highest grade of work. When you purchase a second hand lathe, you have no means of telling how much it has been abused or how much it is out of true. Only an expert has the equipment and ability to make the proper tests necessary to insure you against trouble when purchasing such second hand equipment. A lathe that has been ruined by improper handling is a handicap to good work that is mighty hard to overcome.

With proper handling, a well made watchmaker's lathe is good for a lifetime of service. For this reason, you should treat your lathe with the care to which it is entitled, keeping it clean and oiled at all times and never allowing any person unskilled in its use to try it out or play with it.

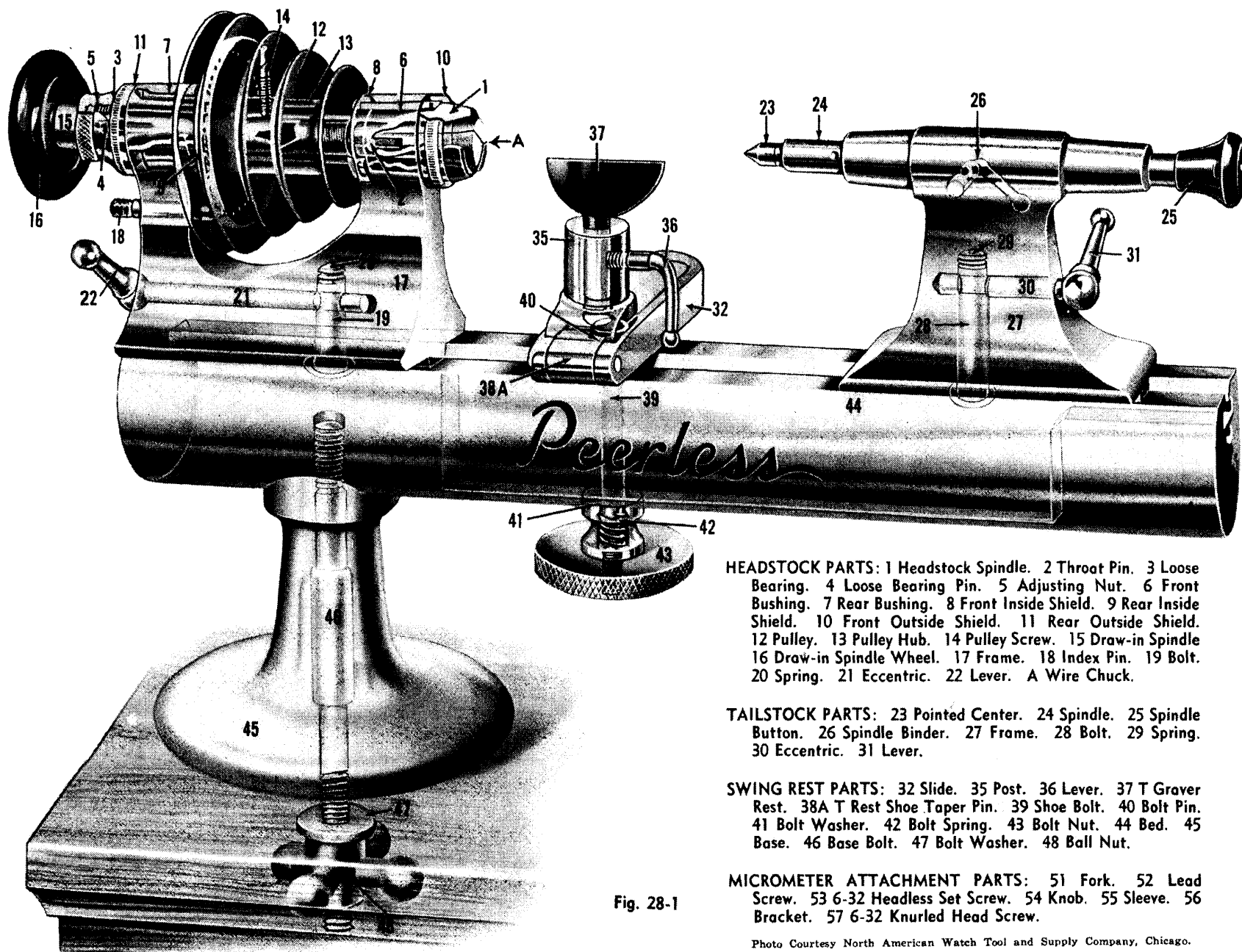


Fig. 28-1

HEADSTOCK PARTS: 1 Headstock Spindle. 2 Throat Pin. 3 Loose Bearing. 4 Loose Bearing Pin. 5 Adjusting Nut. 6 Front Bushing. 7 Rear Bushing. 8 Front Inside Shield. 9 Rear Inside Shield. 10 Front Outside Shield. 11 Rear Outside Shield. 12 Pulley. 13 Pulley Hub. 14 Pulley Screw. 15 Draw-in Spindle. 16 Draw-in Spindle Wheel. 17 Frame. 18 Index Pin. 19 Bolt. 20 Spring. 21 Eccentric. 22 Lever. A Wire Chuck.

TAILSTOCK PARTS: 23 Pointed Center. 24 Spindle. 25 Spindle Button. 26 Spindle Binder. 27 Frame. 28 Bolt. 29 Spring. 30 Eccentric. 31 Lever.

SWING REST PARTS: 32 Slide. 35 Post. 36 Lever. 37 T Graver Rest. 38A T Rest Shoe Taper Pin. 39 Shoe Bolt. 40 Bolt Pin. 41 Bolt Washer. 42 Bolt Spring. 43 Bolt Nut. 44 Bed. 45 Base. 46 Base Bolt. 47 Bolt Washer. 48 Ball Nut.

MICROMETER ATTACHMENT PARTS: 51 Fork. 52 Lead Screw. 53 6-32 Headless Set Screw. 54 Knob. 55 Sleeve. 56 Bracket. 57 6-32 Knurled Head Screw.

Photo Courtesy North American Watch Tool and Supply Company, Chicago.

SEC. 476 — Lathe Nomenclature

The new lathe as it comes from the dealer may be already assembled or it may come "knocked down" for packing, in which case the different parts are assembled but not located in their places on the bed. Figure 28-1 shows a modern American-made lathe together with its nomenclature. The following lists the most common parts:

- 44 Lathe bed
- 17 Frame and headstock
- A Chuck
- 15 Draw in spindle
- 16 Draw in spindle wheel
- 18 Index pin
- 12 Pulley
- 37 T Rest—tip-over style
- 39 Shoe bolt and bolt nut (43)
- 43 Bolt nut
- 27 Tail stock frame

On the bottom of the head stock at 19 is a bolt with T head which fits into the slot in the bed. This bolt is controlled by the locking lever 22. Turn this locking lever until the head of the bolt is at its lowest point and then slide the headstock on the left side of the bed as shown, figure 28-1, the throat in which the chuck A fits being toward the right. The draw in spindle 15 is inserted in the left end of the lathe spindle. The index pin 18 fits in the hole found in the headstock but it is not necessary to have this in place at this time, but rather keep it in your chuck box.

Before attempting to assemble the bed plate, notice that the washer at 41 is counterbored to permit a coiled spring to be placed between this washer and the hand wheel nut 43. It is essential that this spring be in place when these parts are assembled on the bed. The coiled spring keeps a tension on the bolt and prevents to a great extent the danger of the key getting out of its seat. The base of the T rest has a slot which fits over the head of the bolt projecting above the bed plate and the next step is to slip this into place. Loosen the nut enough so that by pressing up on the bolt to overcome the tension of the coil spring, it is possible to slip the T rest into place on the bed plate. Tightening the nut at the bottom permits you to secure the base of the T rest firmly in place on the bed plate and

your assembly will appear as in figure 28-1. The tailstock is placed on the right side of the bed, securing in place with a locking lever as was done with the headstock, but it will not be necessary to use this tailstock at this time.

SEC. 477—The T Rest

On the older model lathes, the T rest was stationary and each time the watchmaker wished to check a measurement and the T rest interfered, it was necessary to loosen the hand nut and move the entire T rest, after which it was again adjusted to the proper position and secured in place by turning the hand nut. The modern tip-over T rest is a great timesaver when compared with the old model. After it is once adjusted to position, it is not necessary to disturb that adjustment. The T rest can be tipped back out of the way, the measurement or fitting tested and the T rest tipped back into its original position.

SEC. 478 — Mounting The Lathe

In mounting a lathe on your bench for use with a motor, drill a hole of proper size to receive the bolt which extends down from the foot of your lathe. This hole for the average size person should be about six inches in from the left side of the bench top and the same distance from the front edge. Secure the lathe in position by means of the hand nut, placing an iron washer between the nut and bench top. If you are going to have the motor connected with the lathe, set the motor on the bench about 8 inches back from the lathe. If the motor is too far from the lathe, the belt is inclined to vibrate too much. See that the cone pulley on the motor is so placed that its largest diameter is opposite the smallest part of the lathe pulley. Have the axis of the motor parallel to the edge of the bench top and fasten in place by means of screws.

The lathe is connected to the motor by means of $\frac{1}{8}$ " twisted leather belting which is preferable to solid round belting. The stopping and starting together with the speed of the motor is governed by means of a foot control which is placed on the floor of the bench in such a position that it is easily reached. When properly connected, pressure on the foot control will start the motor and the further it is pressed down, the faster the speed. When the pressure is re-

leased, the current is shut off and the motor stops.

To connect motor and lathe, thread a piece of $\frac{1}{8}$ inch twisted leather belting through the pulley of the lathe and then over the pulley of the motor. Let the belting rest in the middle groove of each pulley, pull it up rather tight and cut off so the ends of the belting will just come together without lapping. Have the ends of the belt cut off square and punch a hole in each end to receive the fastener which you can make from a piece of brass wire about 1 millimeter in diameter. The hole should be about 3 millimeters from the end and can be made by means of a broach or even a larger needle, twisting it around in the leather until it is of the right size to receive the wire.

Take a piece of one millimeter wire and with a flat or snipe nose plier shape one end as shown in figure 28-2, the space at **A** being slightly smaller than the diameter of the belting. The end forming the hook should be approximately 3 mm long. Make the next bend at **B** and the wire will appear as in figure 28-3. Make a bend at **C**, figure 28-3, at approximately a 45 degree angle. The wire should then appear as in figure 28-4. Flatten the ends of the belting

and start the long end of the wire **D**, figure 28-4, through the inner side of the belt and pull wire through. Thread the belt through the lathe pulley and push the long end of the wire **D** through the hole in the other end of belt and slide belt in place.

Before going further, slip belt over the two pulleys and see if you have the proper tension. If belt is too loose, it may be tightened by taking wire out of one end and then giving it a few twists, or untwist it a few turns to loosen it.

If tension is correct, bend the long end of the wire tight against the belt and cut off wire at **E**, figure 28-4. With the jaws of your flat pliers, press ends of clamps tight against the belt.

SEC. 479 — The Lathe Motor

Figure 28-5 shows a popular type of motor with foot control, which can be used in driving a lathe. These are usually universal motors, working on either AC or DC current with a voltage of from 110 to 130, and come already wired with separate types of plugs on the two free ends of the wire, one a standard plug which fits into the regular receptacle or base connec-

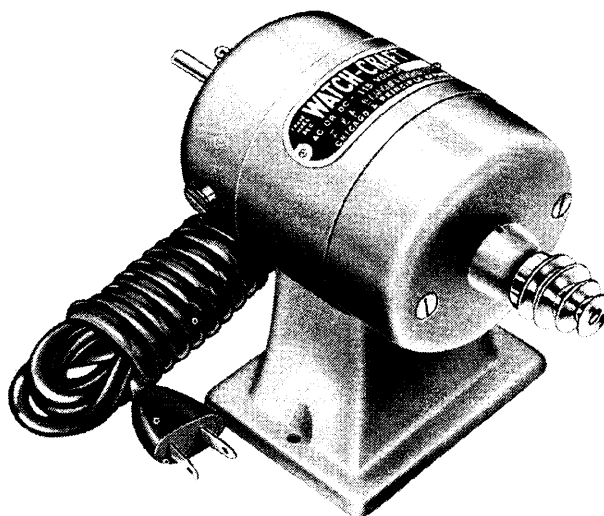
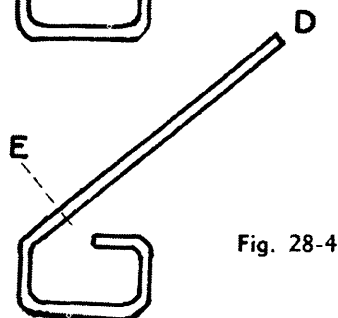
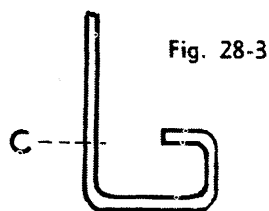
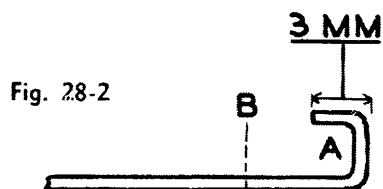


Fig. 28-5

Photo Courtesy North American
Watch Tool and Supply
Company, Chicago.

tion of the house or store current, the other a special plug which fits on the foot control or the connection to the motor, depending on style used. The stopping and starting together with the speed of the motor is governed by means of the foot control which is placed on the floor of the bench in such a position that it is easily reached. When properly connected, pressure on the foot control will start the motor and the further it is pressed down, the greater the speed. When the pressure is released, the current is shut off and the motor stops.

Sec. 480 — Oiling The Lathe

Now having set up your lathe and motor and tested the latter by making sure the electric current is on and properly connected and that the foot control is in working order, it is time to get a little better acquainted with the lathe. As the lathe comes from the factory, it generally is already oiled and greased to prevent rust but it does no harm to go over it again after wiping off all old grease and dust.

As stated before, a lathe as it comes from the factory is good for a great many years of every day service, provided it is properly cared for and never abused. One of the principal causes of lathe failures is a lack of oil and accumulation of dust and grit in the bearings of the head stock. You should always keep your lathe covered when not in use and once a day apply a light grade of oil on the bearings. It is better to apply too much oil than not enough. Push the dust caps at **10 and 11**, figure 28-1, far enough out to permit you to place several good sized drops from your oil can in the oil holes for the bearings. Have your lathe running at a moderate speed and apply oil until it forms a ring around the bearing. Let it continue to run for a half minute or so and then wipe off all surplus oil with a clean cloth. Press the dust caps firmly back in place and again wipe off any oil that may be on the surface.

On some lathes you will find a hole at the inside edge of the dust caps which can be turned until in line with the oil hole in the bearings, thus enabling you to oil the bearings without removing the cap. In others, the dust caps are split. In either of these types, be sure that the hole or the split portion is down to prevent as much as possible the entrance of dirt or grit into the bearings.

Apply a drop of oil on the draw in spindle at **15**; also a drop in the throat of the lathe spindle at **1**, figure 28-1.

SEC. 481 — Footwheels

If you are not convenient to a 115 or 120 volt AC or DC current, it is a very easy matter to arrange your lathe to be driven by a foot wheel. In fact, with a foot wheel driven lathe it is possible to do just as fine work as with a motor.

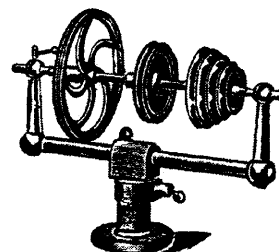


Fig. 28-6

In setting up a lathe with a foot wheel, it is better to use a counter shaft as shown in figure 28-6. The use of a counter shaft eliminates the moving belt that is right in front of you when you are working and also permits a variety of speed and the use of a speed wheel for special work which will be described further on in these lessons.

SEC. 482 — Chucks

Before the invention of the split chuck, any work which was to be turned in a lathe had to be held between centers or clamped on some form of face plate. The "fiddle bow" lathe, some of which are still in use, is an example of the dead center style of lathe. These lathes were generally small and held in a vise. The workman was compelled to use one hand to drive the lathe by means of the so-called fiddle bow, while with the other hand he manipulated the tool upon whatever piece he was working.

The modern watchmaker's lathe uses two general types of chucks for holding work—the hollow split chuck and solid chuck. Your first work will be with the split chuck, sometimes called wire chuck.

Figure 28-7 is an illustration of the conventional type of split chuck as used in the majority of watchmaker's lathes. It is split lengthwise at a trifle over half of its length, to form three

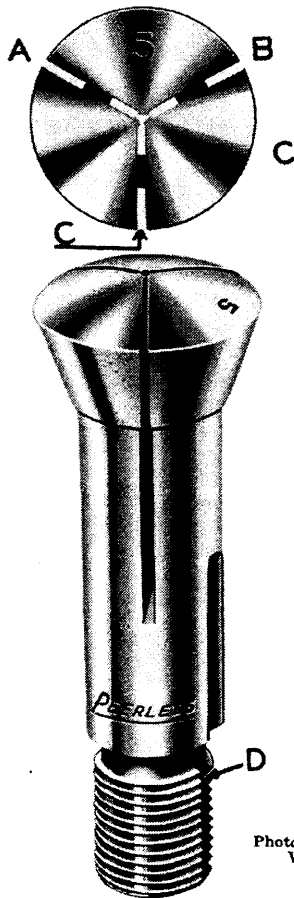


Fig. 28-7

Photo Courtesy North American
Watch Tool and Supply
Company, Chicago.

jaws at the face, these splits being shown at **A**, **B**, and **C**. This chuck fits into the spindle of the lathe and the object to be turned is held firmly in place by the compression of the three split portions. This is accomplished by means of the draw in spindle which fits on the threaded portion of the chuck at **D**. As the chuck is drawn into the throat of the lathe by means of the draw-in spindle, the jaws are forced toward the center and act as a clamp.

A properly made chuck is so tempered that the jaws will close equally when compressed by the draw-in spindle and care must be used to see that they are never sprung out of true.

On the face of each chuck is stamped its size, figure 28-8. This refers to the diameter of the opening in the jaws and this opening when received from the factory has been ground and lapped true and will remain in that condition if treated as it should be. For that reason, you should measure every piece which you wish to "chuck up" and select a chuck according to

the measurement you find.

With some of the older lathes, the chucks were sized to match wire dimensions as found on a stubs gauge but this was not satisfactory to most watchmakers who were not accustomed to working with such a gauge and they found it somewhat confusing owing to the fact that the larger the number on a stubs gauge the smaller the size. Thus a wire that gauges 50 by stubs gauge measures about one and three-fourths millimeter while No. 20 wire would be a trifle over four millimeters in diameter.

The universal standard for marking and gauging chucks at the present time is one tenth of a millimeter. If the chuck is stamped 20, it means that its opening in the jaws is twenty tenths of a millimeter or 2 mm, No. 8 equals $\frac{8}{10}$ mm, 16 equals $1\frac{6}{10}$ or decimally 1.6 mm, etc. This makes it very easy for the workman to select the proper chuck by merely measuring the piece he wishes to hold in the chuck, provided he has a millimeter gauge and knows how to use it.

If a workman has but a small assortment of chucks, he may be tempted to use one that is too large or too small and thus spring the jaws to such an extent that it will never run true.

For this reason, it is well to secure as large an assortment of chucks as you can afford when purchasing a lathe. For your preliminary lathe work, you can get along very nicely with 10 chucks but when you are prepared to do all kinds of watch repairing, do not have less than 24 split chucks beside the taper chuck and cement chuck which come with the lathe.

For a complete set of split chucks, one each of the following numbers is recommended: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 47, 48 and 50. This will insure your having a sufficient variety of split chucks for practically all ordinary watch work you may be called upon to do. Later you can add to these any which you may find necessary.

In the spindle of the lathe is a pin or key to match the slot or key seat shown at **2**, figure 28-1. It is necessary that the key seat in the chuck matches this key in the spindle when you place any chuck in the headstock of a lathe. Occasionally this key is worn or cut off by having a chuck forced into place but this can be avoided by anyone who will learn to seat each chuck properly.

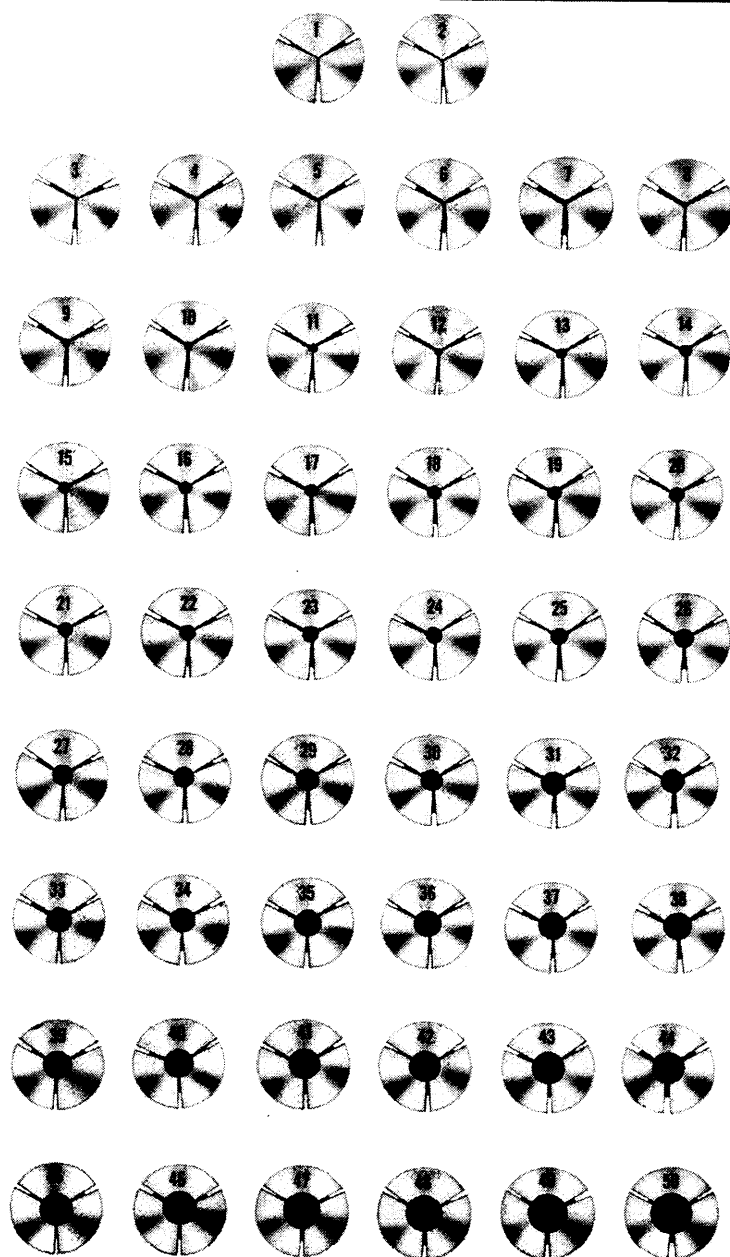


Photo Courtesy North American Watch Tool
and Supply Company, Chicago.

Fig. 28-8

SEC. 483 — Types of Gravers

There are two common shapes of gravers used in turning, the square and lozenge or diamond shape as indicated in figure 28-9.

The square graver is most commonly used and it is this form that you will use in your preliminary lathe work. It can be had in different sizes but the most practical for all around work should be from $2\frac{1}{2}$ to 3 mm square. As it

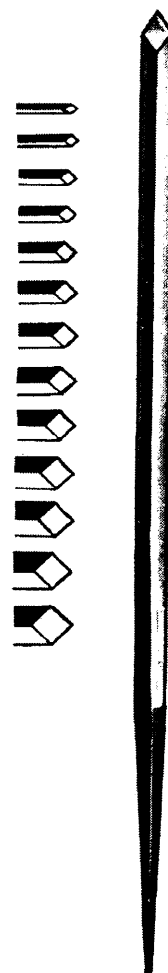


Fig. 28-9



Fig. 28-10

comes to you it is about $5\frac{1}{2}$ inches long and should be mounted in a handle before using. The most practical type of handle is shown in figure 28-10, a pivot graver handle. This is somewhat on the order of a file handle though shorter and about $\frac{1}{4}$ " in diameter. These handles generally are drilled ready to receive the graver. In mounting the graver, it is only necessary to clamp the graver in a vise with the tapered end out and drive the handle down

firmly in the graver. Some prefer to "burn in" the handle in which case the end of the graver protruding above the vise is heated to a red heat by means of a blow torch or bunsen burner and the handle driven on as before while the graver end is red hot. Care must be used to see that the balance of the graver is not heated enough to draw the temper on the cutting edge.

You will find, however, that it will prove satisfactory to merely drive the handle on with heating provided you do not drive it hard enough to split the handle. A series of sharp taps is better than attempting to drive it down with one or two hard blows.

The new graver will be found to have the end cut off at about the correct angle but the edges are liable to be rather round and your first step after mounting will be to sharpen it ready for turning. To do this, you should provide yourself with a combination oil stone of good quality, figure 28-11, one side of which is coarse for rapid cutting and the other much finer for finishing. Be sure to use plenty of oil



Fig. 28-11

on the stone when sharpening the graver in order to keep the surface in good cutting condition. If the stone is used dry, the small particles of steel ground off the tool will imbed themselves in the pores of the stone and in time the surface will become glazed and greatly hinder its use for sharpening. Plenty of the right type of oil will prevent this and keep the stone in first class condition. Never use a vegetable oil for this purpose, however. Ordinary kerosene will give very good results and it is well to have a bottle of this always at hand and keep the surface of your oil stone saturated with it whenever sharpening the tool. Thoroughly wipe off the stone when you are finished and thus have it clean and ready the next time it is used.

SEC. 484 — Sharpening the Graver

The angle of the cutting end of the graver should be about 45 degrees for the general run of lathe work as shown in figure 28-12. As received from the manufacturer, the graver is usually ground at about that angle but as stated

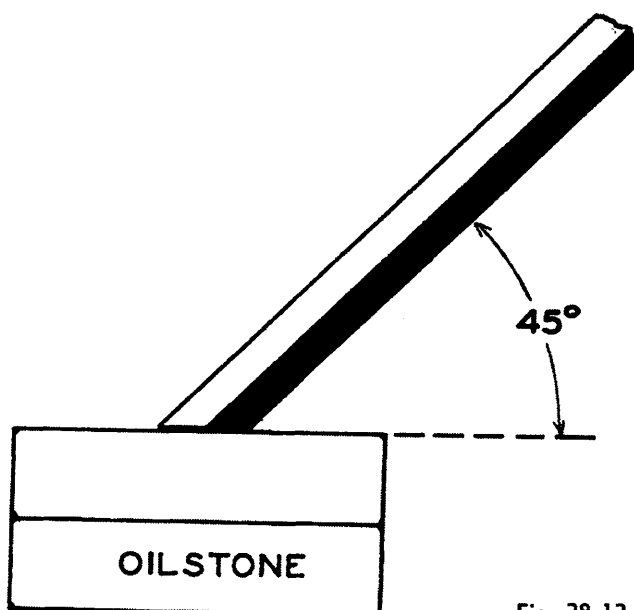


Fig. 28-12

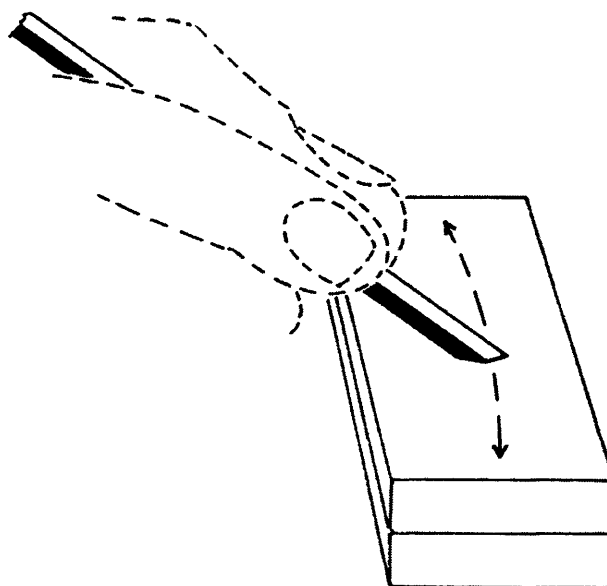


Fig. 28-13

before, it is too rough and should be resharpened on a fine oilstone. If you find this angle about correct, you need only smooth it upon the finer side of your combination oil stone. Place a liberal supply of oil on the stone and holding the graver as shown in figure 28-13, grind it by moving the hand steadily back and forth as indicated by the double headed arrow. The graver should be held so that an imaginary line down through the upper and lower angular corners of the tool will be at right angles with the surface of the stone. If the graver is twisted either to right or left, the result may appear as in figure 28-14. The beginner usually has a tendency to roll the handle slightly while moving it back and forth thus giving the face of the graver a convex surface instead of flat.

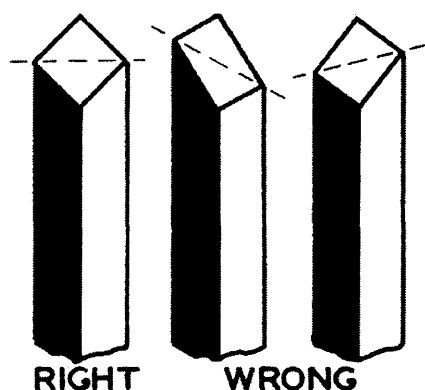


Fig. 28-14

The contact of the cutting edge and the moving piece generates heat, the degree being dependent upon the depth of cut and speed. To keep the tool as cool as possible some sort of coolant is applied to its edge to carry off this frictional heat. With the old type of carbon steel cutters, the speed had to be kept slow enough to prevent them from losing their cutting temper. With some of the new alloy cutting bits, the cutting edge is retained even though the cutter reaches a red heat.

The greater portion of turning in lathe work as done by watchmakers is accomplished by hand tools and high speed with heavy cuts is not so essential.

Before applying the graver to whatever you may be turning, it is well to test the point of your graver. This may be done on your thumb nail. If you rest the point of a properly sharpened graver on your nail as shown in figure 28-15 without exerting any downward pressure except the weight of the graver and while so holding it press lightly in the direction indicated by the arrow, the point will catch in the surface of the nail, while if the graver is dull the point will slip over the nail without catching. If the graver proves to be dull, proceed to sharpen it before attempting to cut anything.

It is essential that you as a student follow these instructions very closely. Do not attempt to proceed with the next lesson until you have satisfactorily sharpened your gravers.

SEC. 485 — Modern Lathe Mount

Figure 28-16 illustrates a watchmaker's lathe and motor mounted on an aluminum base. With this arrangement the watchmaker can move his lathe to suit his purpose. It can be removed from the bench when not in use, thus allowing the watchmaker additional room.

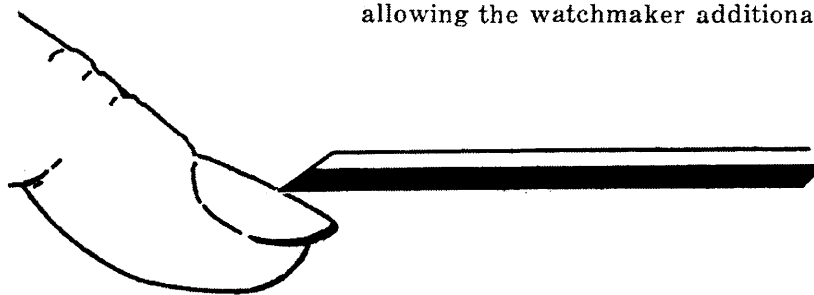


Fig. 28-15

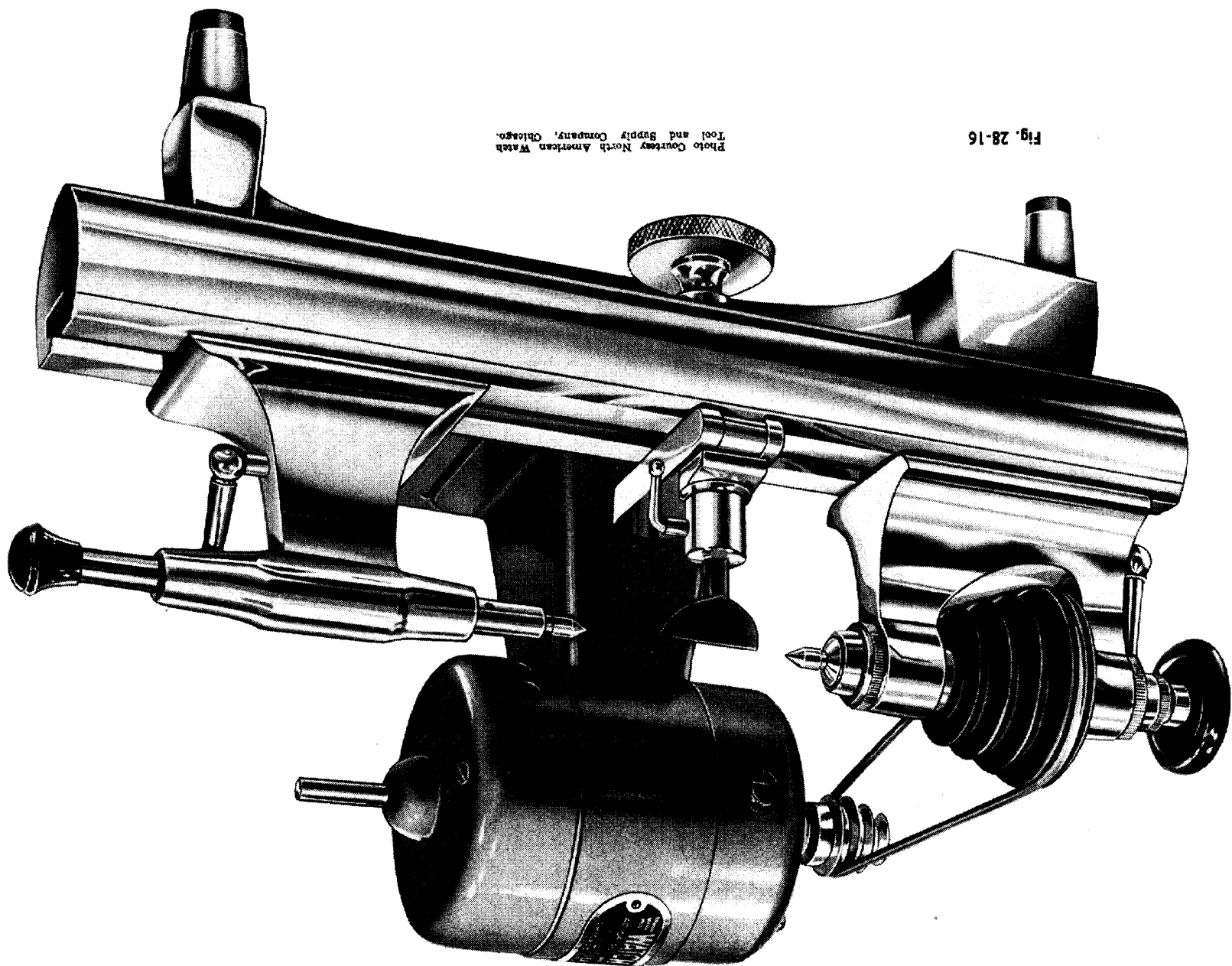


Fig. 28-16

Photo Courtesy North American Watch
Tool and Supply Company, Chicago.

note:

(No job sheets are associated with Lesson 28)