Technology Metal 1, Fundamental Skills, Part A

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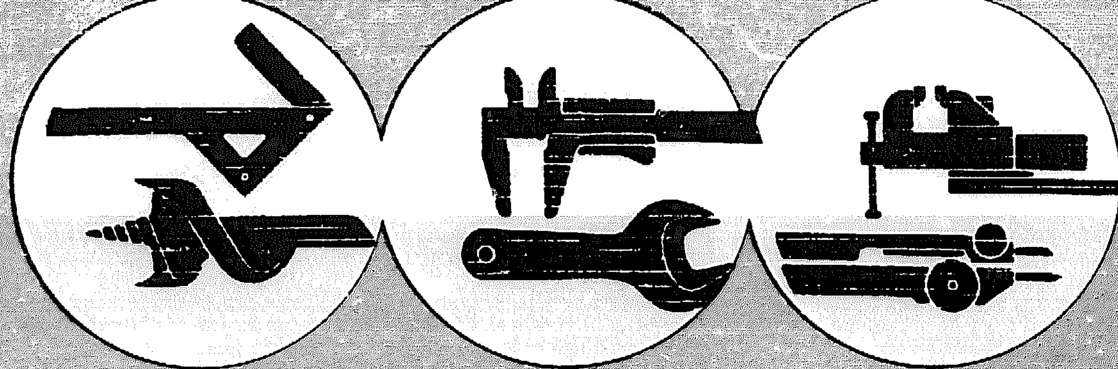
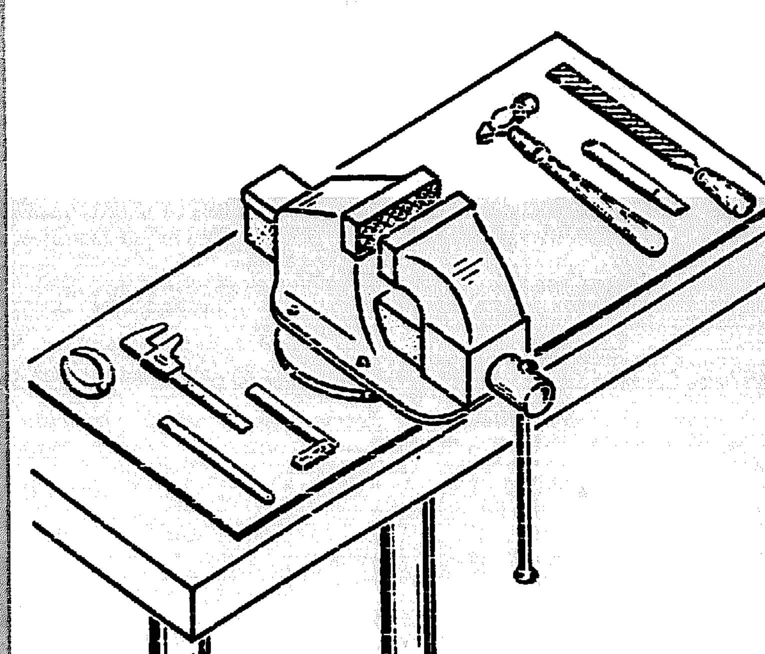


TECHNOLOGY METAL 1

FUNDAMENTAL SKILLS

PART A



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Intercontinental Technical Education Materials & Services

TECHNOLOGY METAL 1

PART A

FUNDAMENTAL SKILLS

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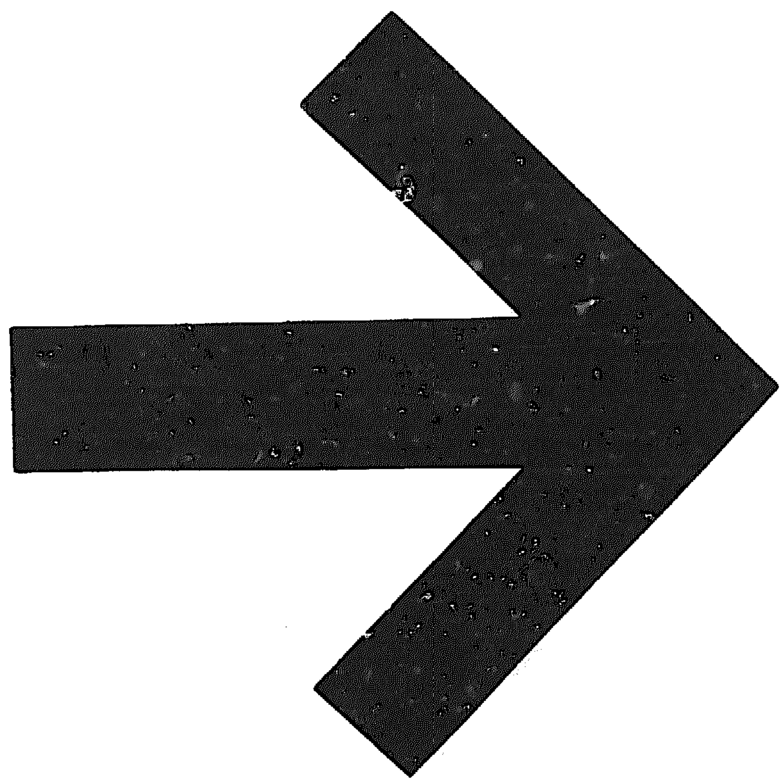

TECHNOLOGY METAL 1

PART A: FUNDAMENTAL SKILLS

SERIES TECHNOLOGY METAL

TECHNOLOGY METAL I

Part A: Fundamental skills
Part B: Workshop processes
Part C: Mechanisms, transmissions and fittings
Part D: Introduction to machine-tools
Part E: The workshop, organisation and maintenance

TECHNOLOGY METAL II

Part A: Hand and power tools for fitting
Part B: Limits and tolerances
Part C: Sheet-metal work
Part D: Machine tools
Part E: Soldering and welding
Part F: Forging
Part G: Pipe fitting and installation
Part H: Ferro materials

TECHNOLOGY METAL III

Part A: Turning
Part B: Milling
Part C: Shaping
Part D: Non-ferro materials

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Safety
Technical drawing, blue-print reading and free-hand sketching
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INTEMS PICTORIAL SYSTEM

MEASURING 1

UNIT OF LENGTH

To indicate the dimensions of any work, units of length are used. One such unit is the metre (m).

1 Measuring

The metre is divided into 100 equal parts. One hundredth part of a metre is called a centimetre (cm). So a hundred centimetres make one metre.

2 One centimetre

Again a centimetre is divided into ten equal parts called millimetres (mm).

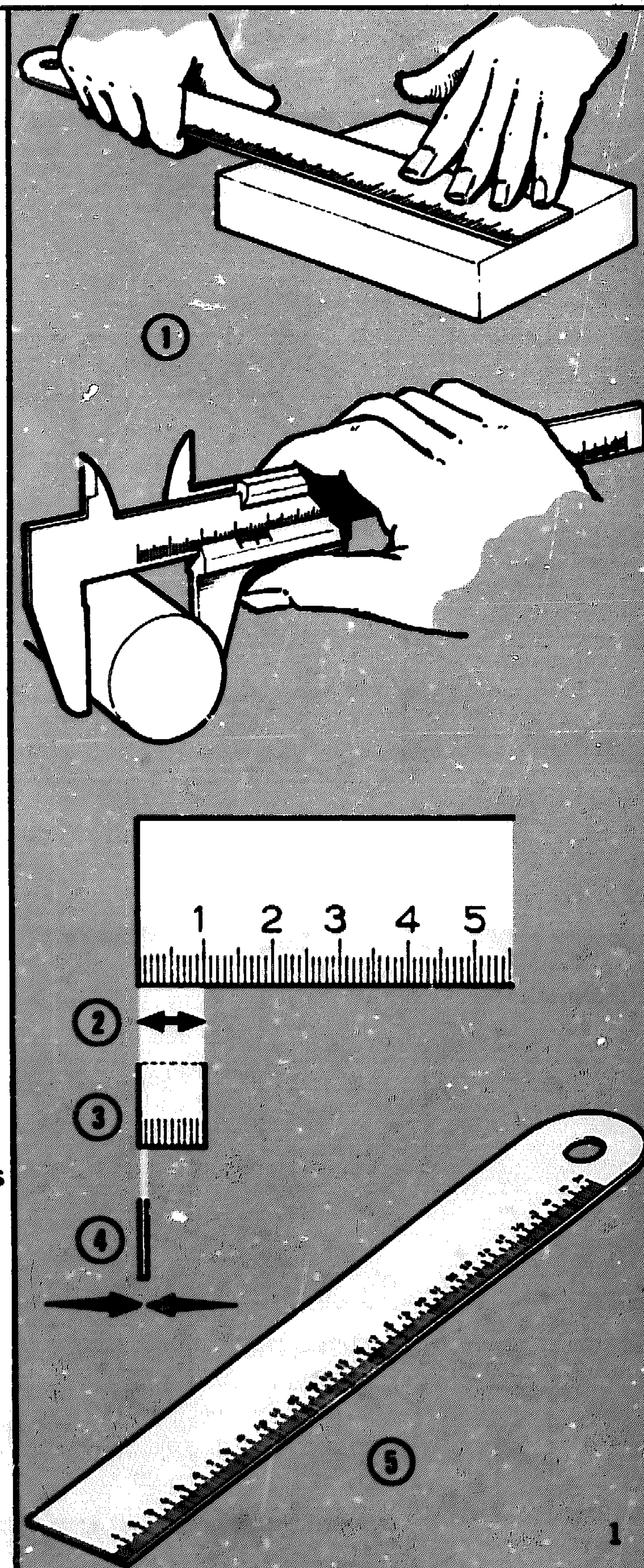
3 Ten millimetres

10 millimetres make 1 centimetre, 100 centimetres make 1 metre.

4 One millimetre

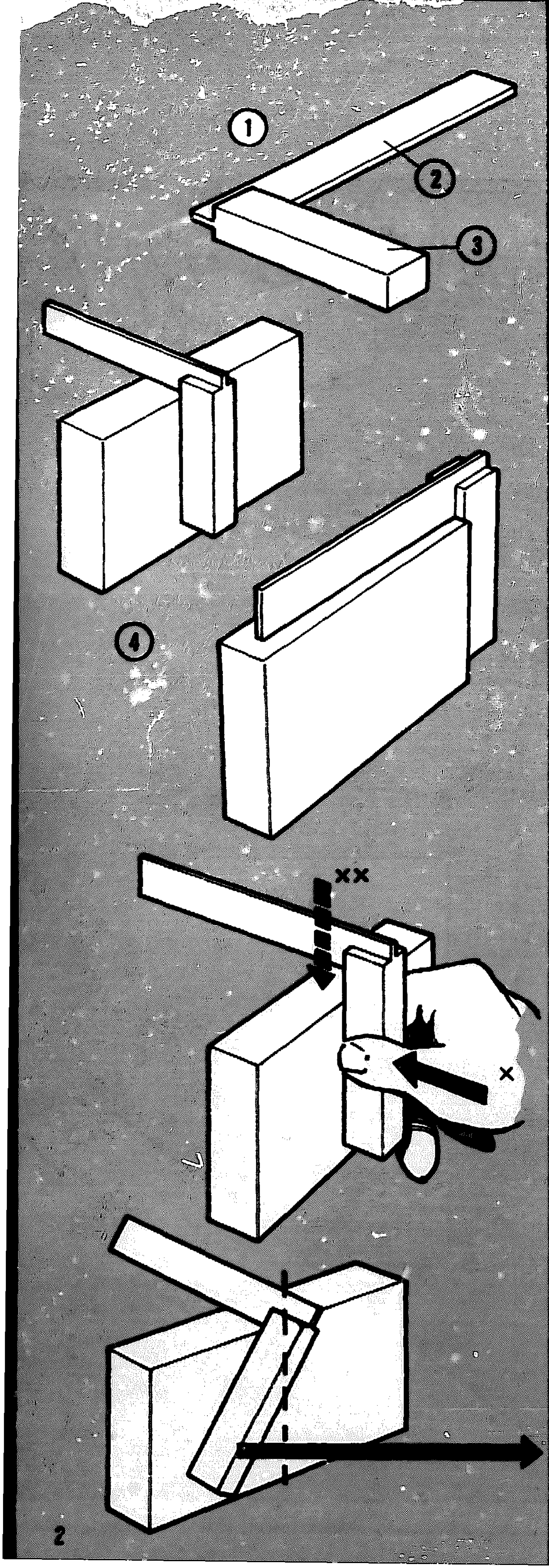
A rule is usually 30 cm long, with divisions in centimetres and millimetres. Sometimes the first part has divisions of half millimetres.

5 Measuring rule



1

TRY SQUARE



1
Try square
2
Blade
3
Stock

The try square is used for testing the squareness of two surfaces.
"Square" means at right angles.

4
Testing a workpiece

X first press

XX then lower

For testing, first press the stock to the work, then lower the try square until its blade makes contact.

Always keep the try square at right angles to the surface to be tested.

WRONG

BEVEL

A bevel is used to test whether the angles between two surfaces are the same everywhere.

There are bevels with an adjustable blade which can be used for all angles.

Another type of bevel is the fixed one, which can be used for one angle only.

1
Adjustable bevel

The bevel shown in fig. 2 is used for angles of 135 and 45 degrees.

2
Bevel with fixed angle

The bevel of fig. 3 is meant for angles of 120 and 60 degrees.

3
Fixed bevel

An angle is measured by degrees.
The angles shown here are:

30 degrees (30^{0})

60 degrees (60^{0})

135 degrees (135^{0})

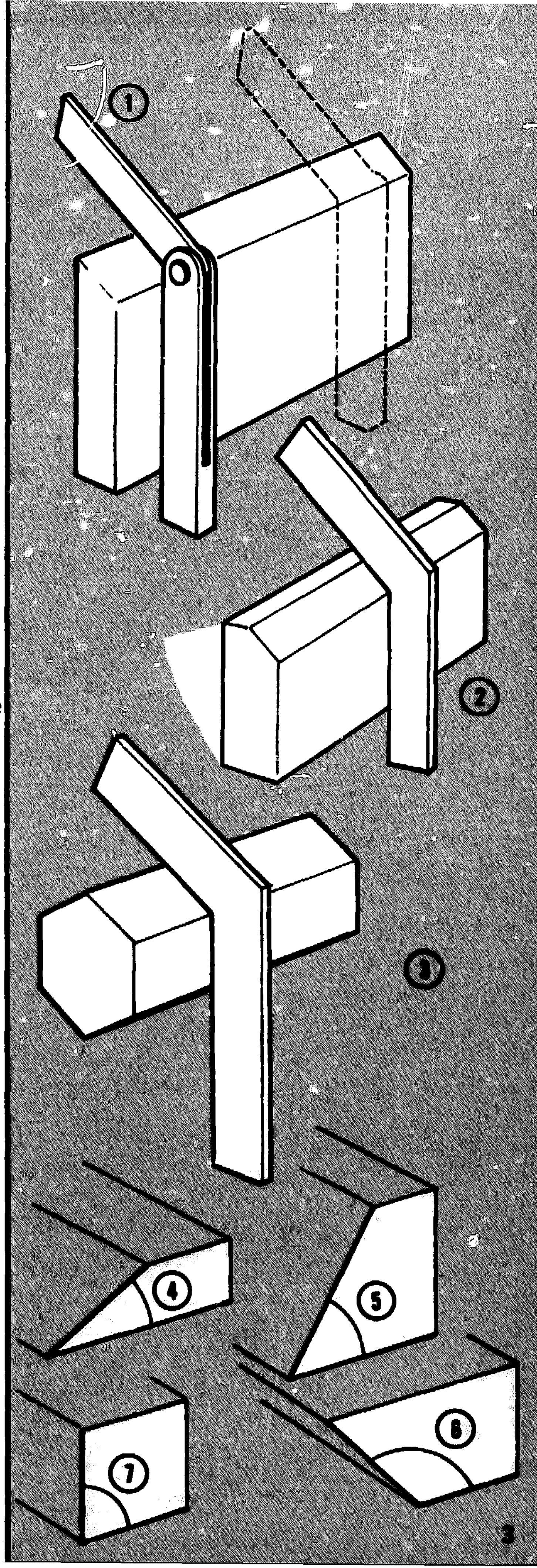
A right angle is 90^{0}.

4 30^{0}

5 60^{0}

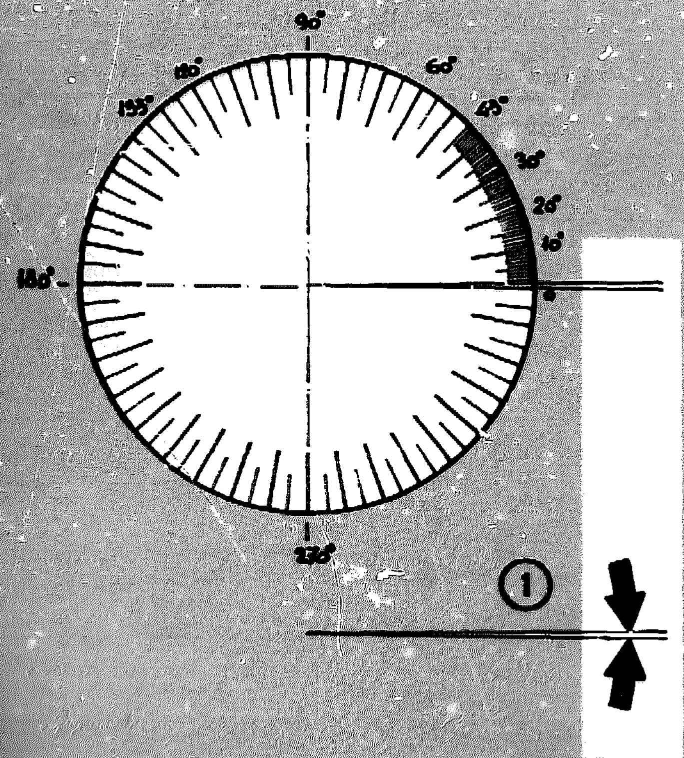
6 135^{0}

7 90^{0}

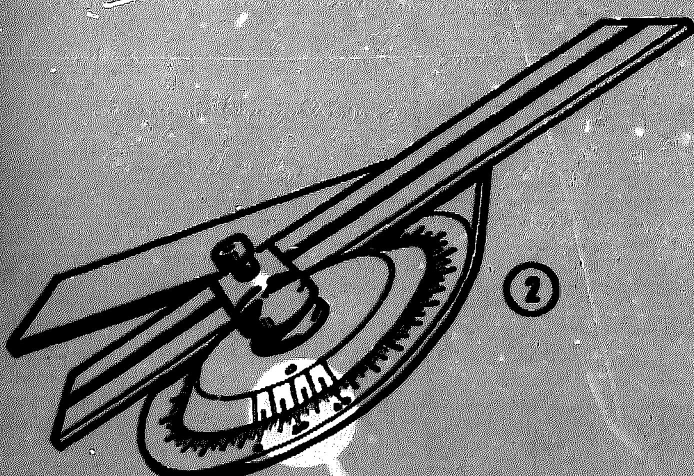


BEVEL PROTRACTORS

A circle can be divided into 360 equal angles. Each angle is called one degree. So a circle is 360 degrees (360°).

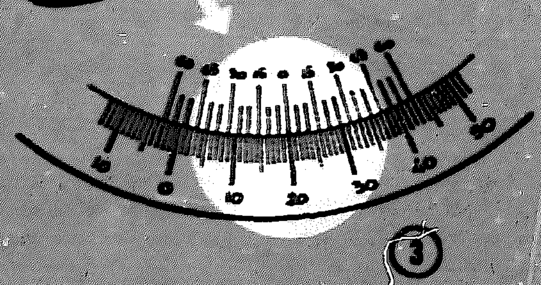


1
One degree (1°)

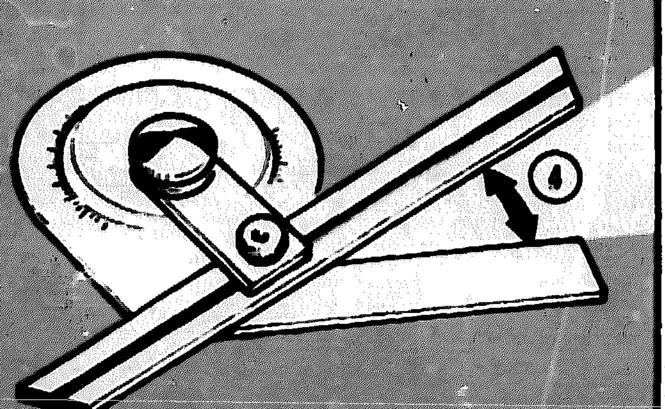


2
Bevel protractor

A bevel protractor is an instrument for measuring angles. If the zero-line on one of the scales is set opposite a number on the other scale this indicates the number of degrees of the angle between the blades.



3
Bevel protractor set to 20°

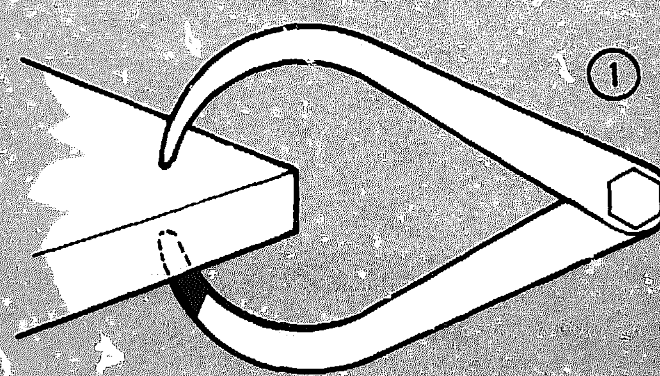


4
Angle between the two blades

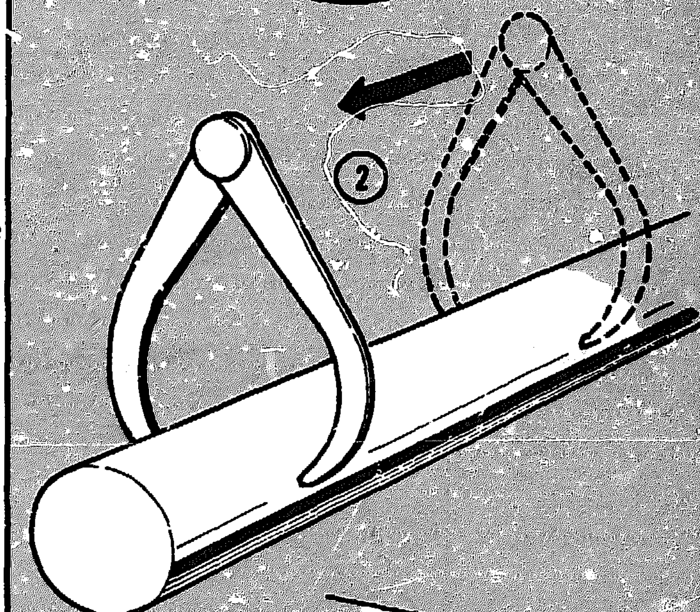
CALLIPERS

Outside callipers are used for checking whether the thickness of a workpiece is the same everywhere.

1
Outside callipers



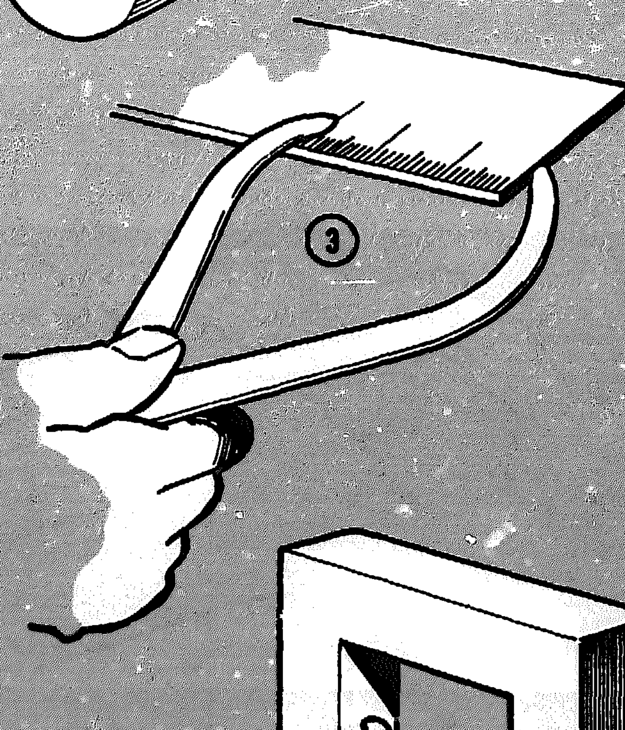
2
Checking the diameter of a rod



Outside callipers are also used for setting off and checking dimensions.

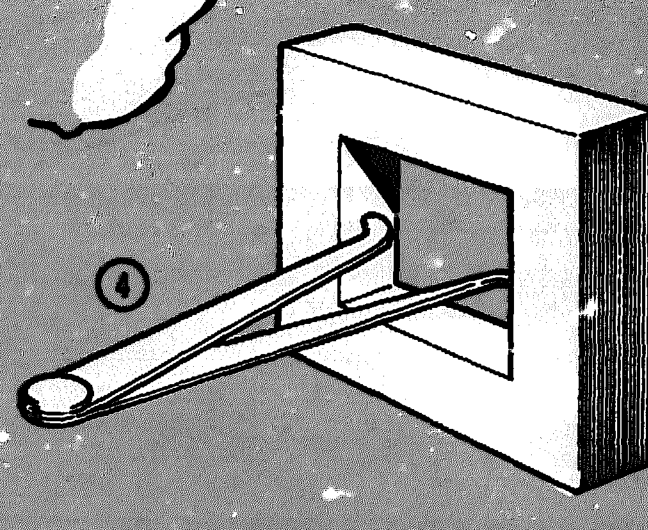
The calliper legs should move smoothly but not too easily.
Callipers are held between thumb and forefinger.

3
Setting to required measurement

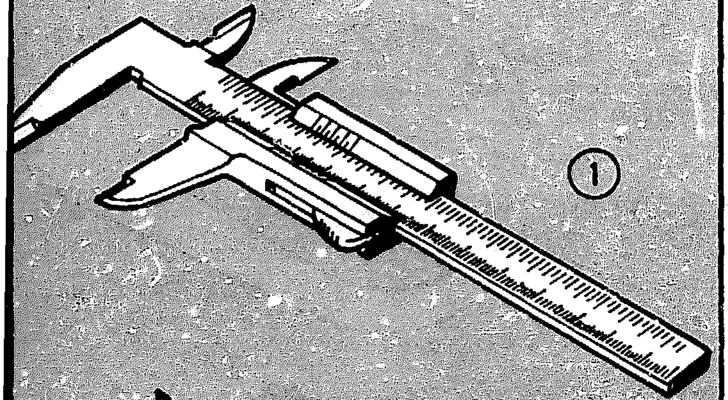


For inside dimensions, inside callipers are used.

4
Inside callipers

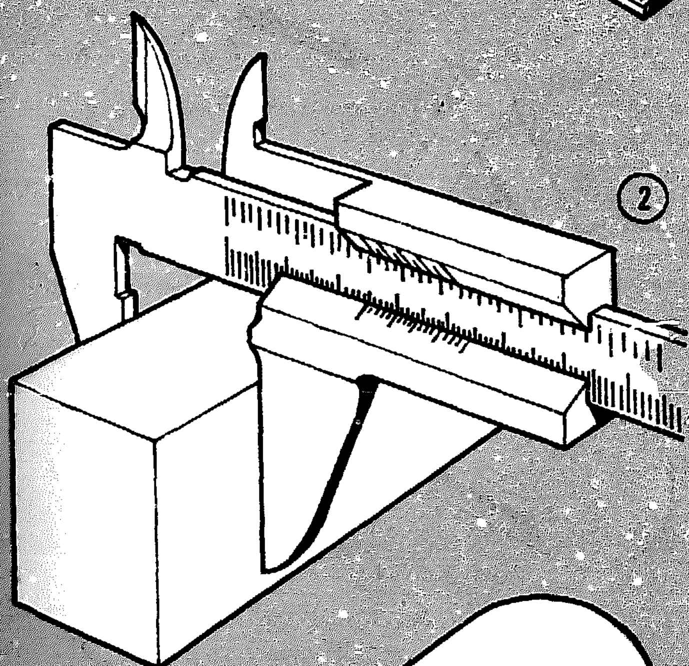


VERNIER CALLIPERS



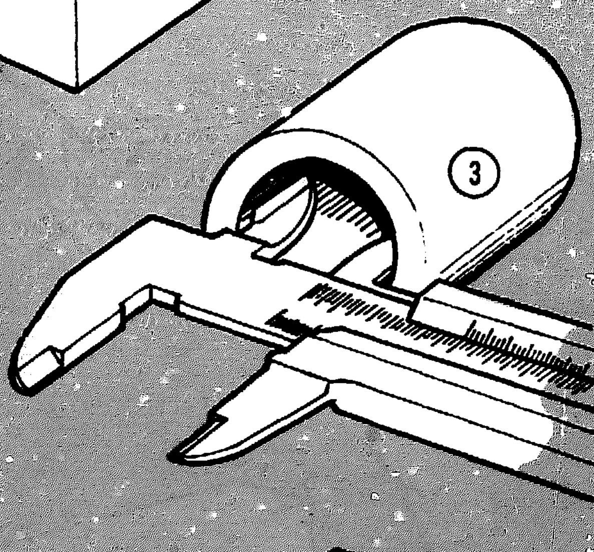
1
Vernier callipers

Vernier callipers are used for more accurate measuring than can be achieved with a measuring rule.

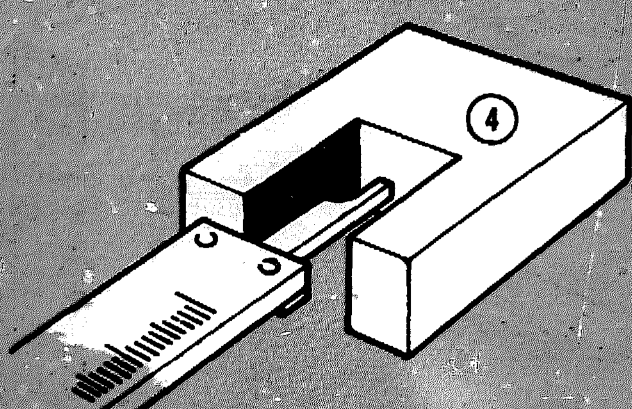


2
Measuring outside dimensions

Inside and outside dimensions as well as depths can be measured with vernier callipers.



3
Measuring inside dimensions



4
Measuring depths

Ensure that the recess in the depth gauge is in the corner.

Rules and vernier callipers may be graduated either in millimetres or in inches, or they may carry both graduations.
One inch (1 in or 1") equals 25.4 mm.

The movable part of the vernier callipers is called the sliding head.

On the sliding head there is also a division called the vernier scale.
With both metric and inch scales the degree of accuracy at which the reading can be taken, varies. The most common graduations are given below.

Measuring to within 0.1 mm.

Measuring to within 1/128 in.

Measuring to within 0.05 mm.

Measuring to within 0.001 in.

In this position the two outer lines of the vernier scale coincide with the zero line and another one of the fixed scale. In this case the ninth line.

1 Millimetres

2 Inches

3 Sliding head

4 Vernier scale

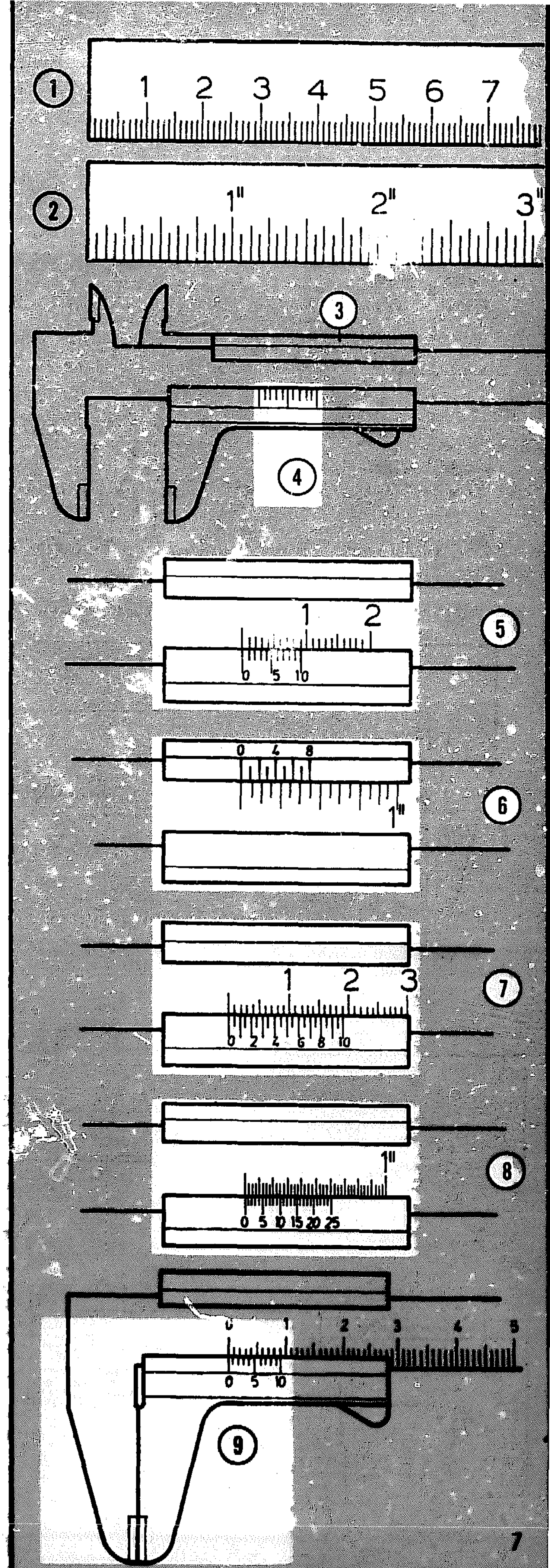
5 Accurate within 0.1 mm

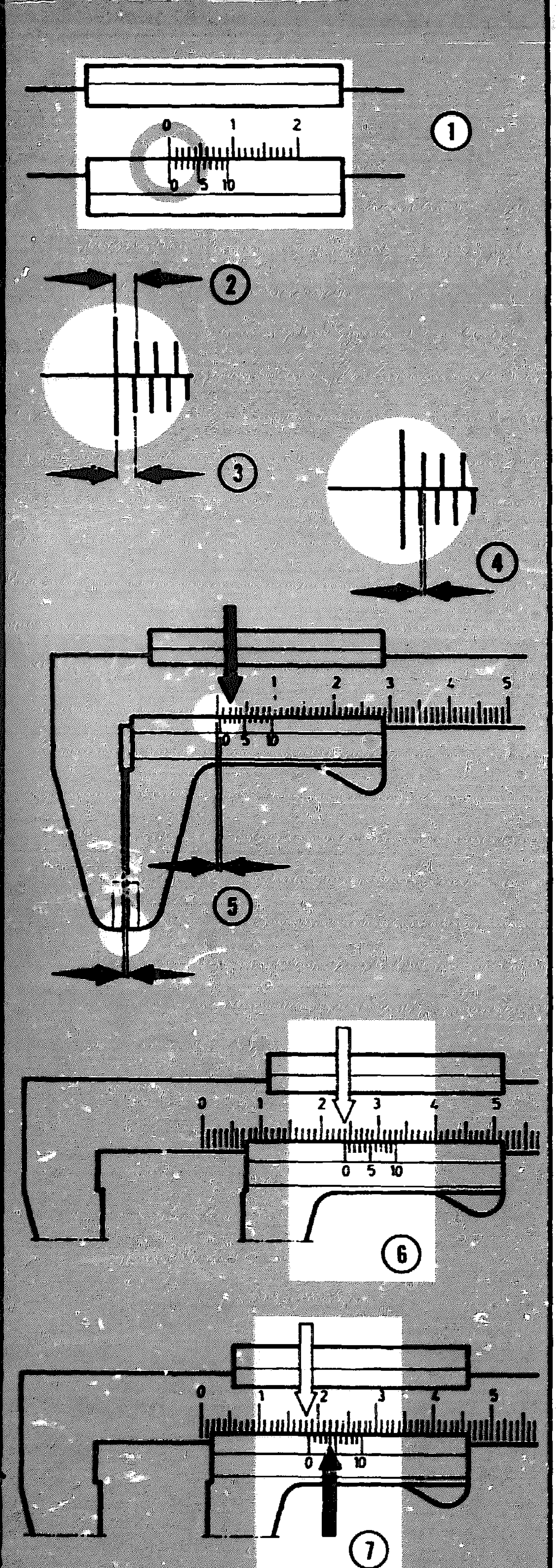
6 Accurate within 1/128 in

7 Accurate within 0.05 mm

8 Accurate within 0.001 in

9 Closed position





1 Accurate within 0.1 mm	Measuring with vernier callipers to within 0.1 mm.
2 On bar scale 1 mm	The bar of the vernier callipers is marked off in millimetres.
3 On vernier scale 0.9 mm	The vernier scale is divided into ten equal parts. Each division is equal to 9/10 mm.
4 Difference 0.1 mm	Consequently the difference between one division on the bar scale and one division on the vernier scale is 1/10 mm.
5 Space between jaws 0.2 mm	When the 2 on the vernier scale is opposite the 2 mm mark on the bar scale - as shown here - the space between the jaws is 2/10 mm.
6 Space between jaws 24 mm	In this figure the zero on the vernier scale is opposite the 24 mm mark on the bar scale (see white arrow). So the space between the jaws is 24 mm.
7 Space between jaws 18.4 mm	Here the zero on the vernier scale is past the 18 mm mark on the bar scale (white arrow) while the 4 on the vernier scale coincides with a line on the bar (black arrow). The reading is 18.4 mm, so the distance between the jaws is also 18.4 mm.

Measuring with vernier callipers to within 1/128 in.

1
Accurate within 1/128 in

The vernier scale has a total length of 7/16 in, and is divided into 8 parts. Each division is then 7/128 in.

2
On vernier scale 7/128 in

The bar scale is marked off in 1/16 in.
1/16 in is equal to 8/128 in.

3
On bar scale 8/128 in

Difference between one division on the bar scale and one division on the vernier scale is 1/128 in.

4
Difference 1/128 in

When 1 on the vernier scale coincides with first line next to the zero line on the bar scale, the space between the jaws is 1/128 in.

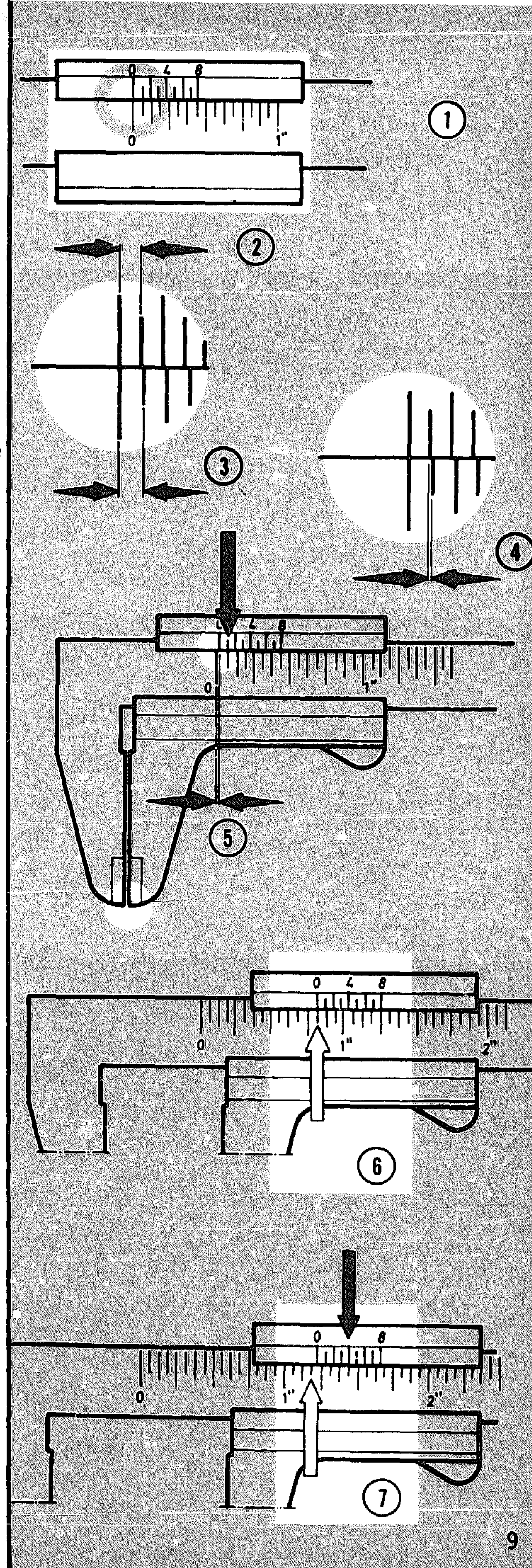
5
Space between jaws 1/128 in

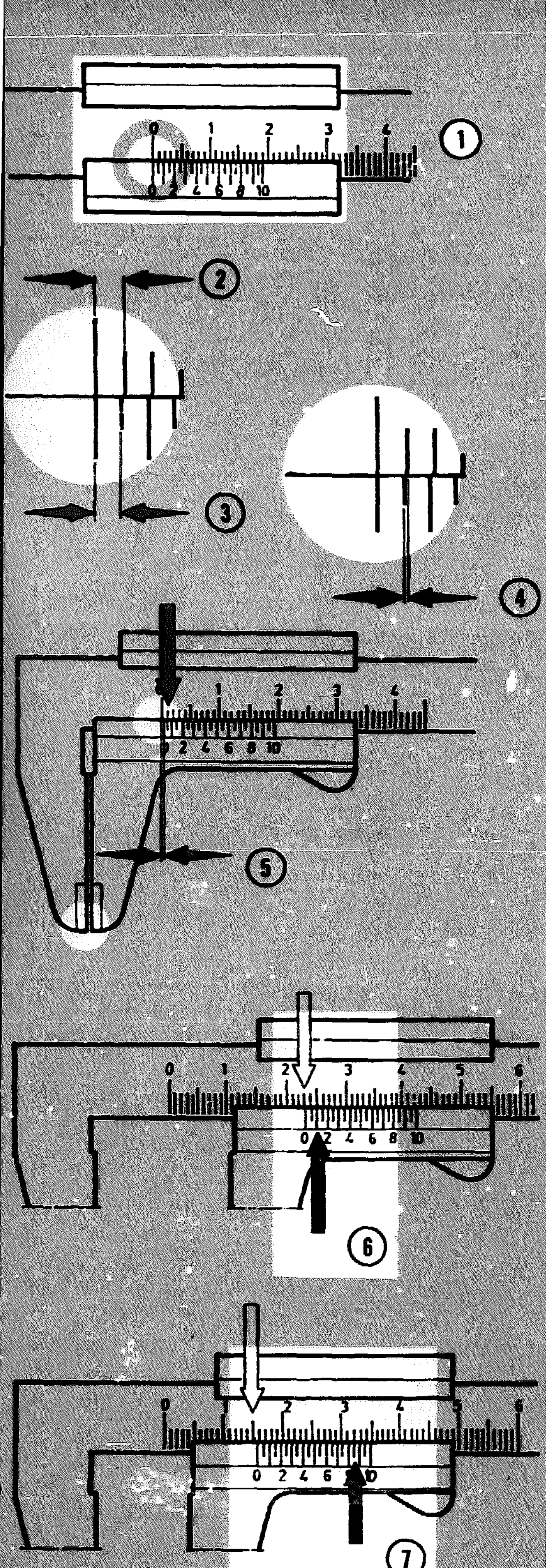
Here the zero of the vernier scale coincides with the 13th line on the bar scale.
So the reading is 13/16 in.

6
Space between jaws 13/16 in

In fig. 7 the vernier zero is past 1 in and again past 3/16 in (white arrow).
Furthermore the fourth line of the vernier scale coincides with a line on the bar scale (black arrow).
This means 4/128 in or 1/32 in. So the reading taken is 1 in + 3/16 in + 1/32 in = 1 7/32 in.
This equals 30.95 mm (see table on page 16).

7
Space between jaws 1 7/32 in





1 Accurate within 0.05 mm	Measuring with vernier callipers to within 0.05 mm.
2 On bar scale 1 mm	Each division on the bar scale is 1 mm.
3 On vernier scale 0.95 mm	The vernier scale is 19 mm long and divided into 20 equal parts. Each division is 19/20 mm, which is equal to 0.95 mm.
4 Difference 0.05 mm	The difference between one division on the bar scale and one division on the vernier scale is 1/20 mm or 0.05 mm.
5 Space between jaws 0.05 mm	When the first line on the vernier scale coincides with the 1 mm mark on the bar, the space between the jaws is 0.05 mm.
6 Space between jaws 23.10 mm	Here the zero of the vernier scale is past 23 mm (white arrow) and the second line (black arrow) coincides with a line on the bar. This means 2 x 0.05 mm = 0.1 mm, so the reading is 23.1 mm. The numbers at the lines indicate tenths of one millimetre.
7 Space between jaws 15.85 mm	Here the zero of the vernier scale is past 15 mm (white arrow). The black arrow shows that the distance past 15 mm is 0.85 mm. So the reading is 15.85 mm.

Measuring with vernier callipers to within 0.001 in.

1
Accurate within 0.001 in

Each inch on the bar scale is divided into ten equal parts. Each part of 1/10 in is subdivided into four small parts. In all, therefore, there are 10 x 4 = 40 divisions each equalling 0.025 in.

2
On bar scale 0.025 in

The vernier scale has a length equal to 24 bar scale divisions but it is divided into 25 equal parts so that each vernier division equals 24/25 x 0.025 in = 0.024 in.

3
On vernier scale 0.024 in

The difference is:
0.025 - 0.024 = 0.001 in.

4
Difference 0.001 in

When the 1 on the vernier scale coincides with the 1 mark on the bar the space between jaws is 0.001 in.

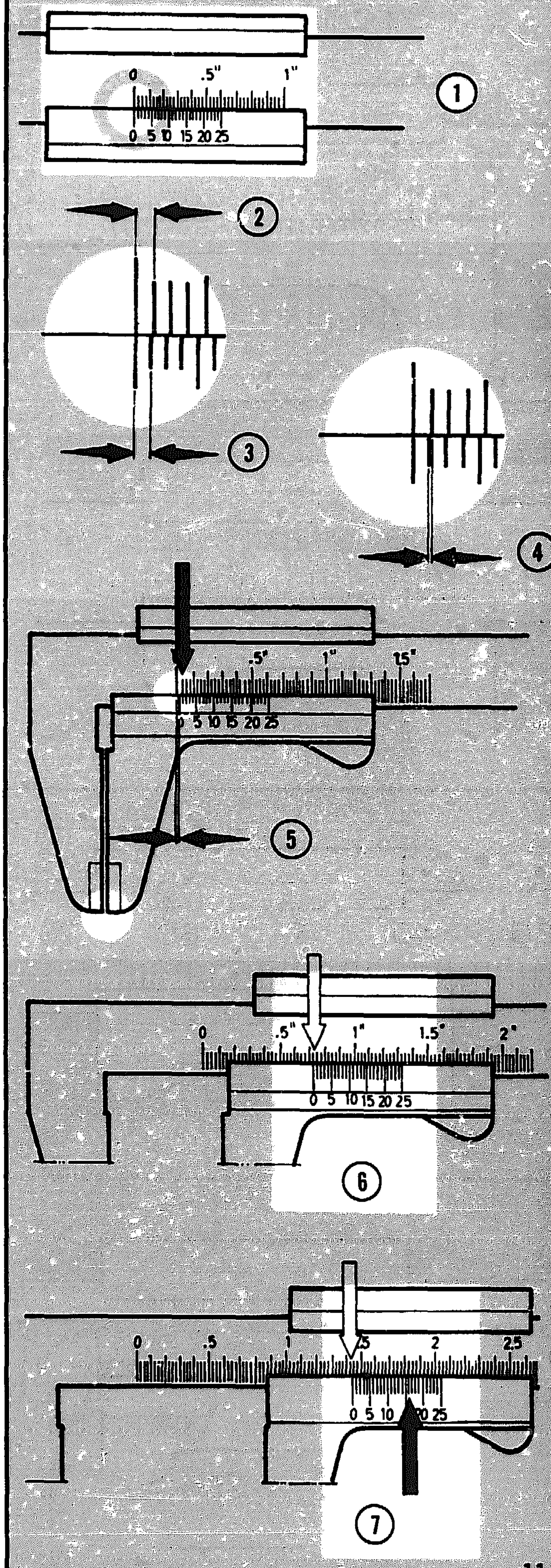
5
Space between jaws 0.001 in

In fig. 6 the vernier zero coincides with the first line past 0.700 in, so the reading is 0.700 + 0.025 = 0.725 in.

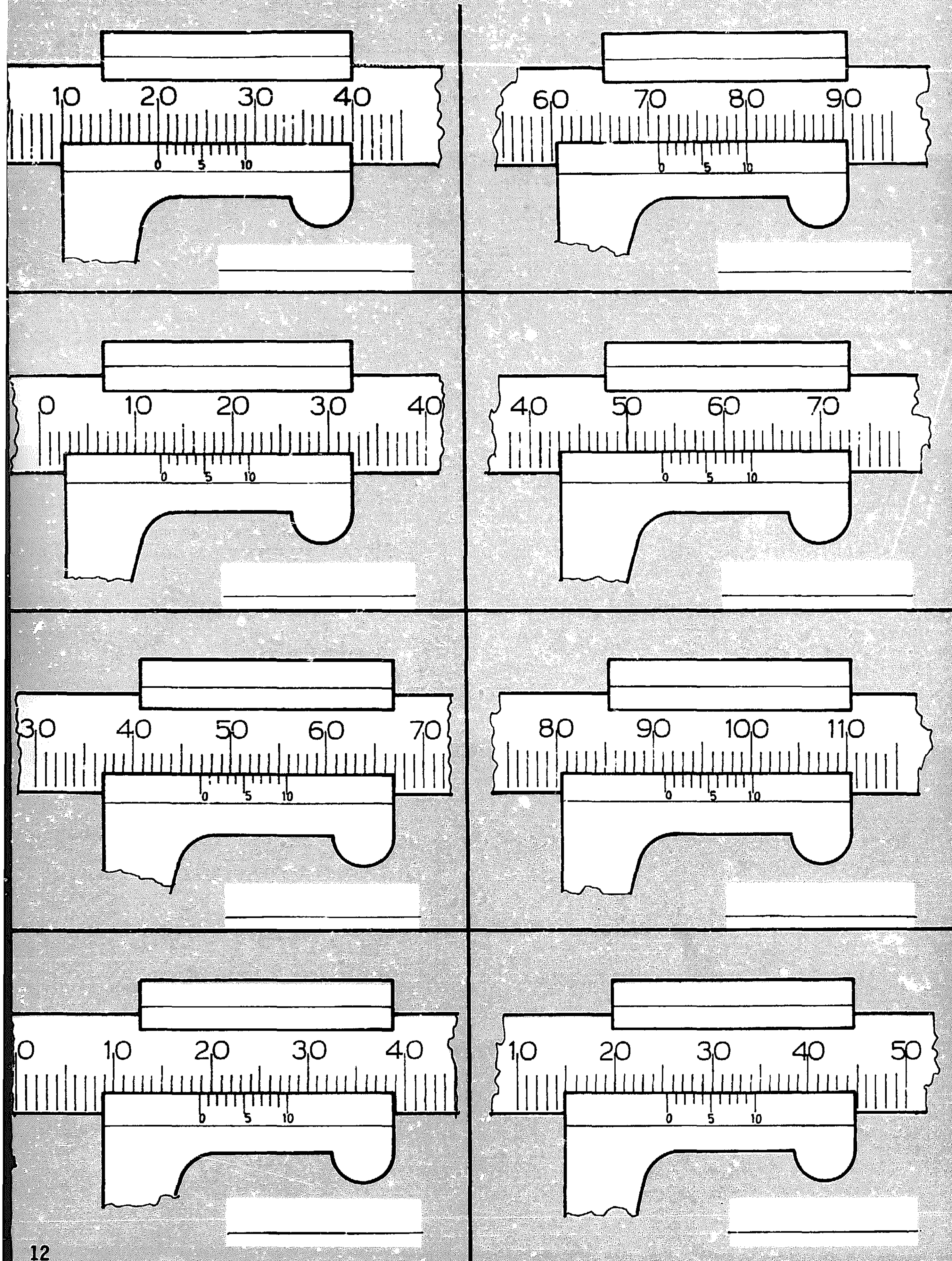
6
Space between jaws 0.725 in

In fig. 7 the vernier zero is past the first line after 1.4 in. So 1.4 in + 0.025 in= 1.425 in (see white arrow), and the 16th line of the vernier scale coincides with a line on the bar (black arrow). Hence 0.016 in should be added to the first value read, and the result is 1.425 + 0.016 = 1.441 in.

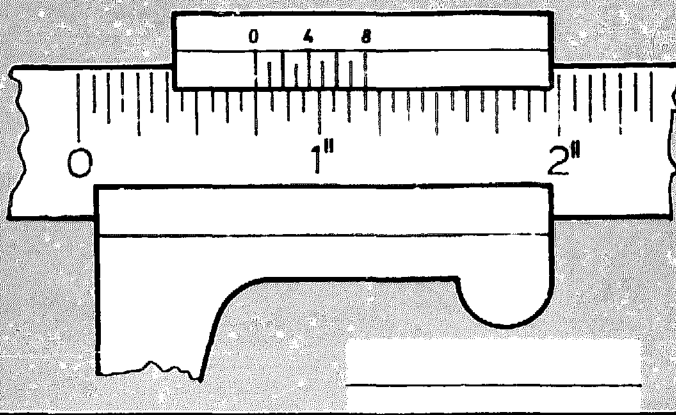
7
Space between jaws 1.441 in

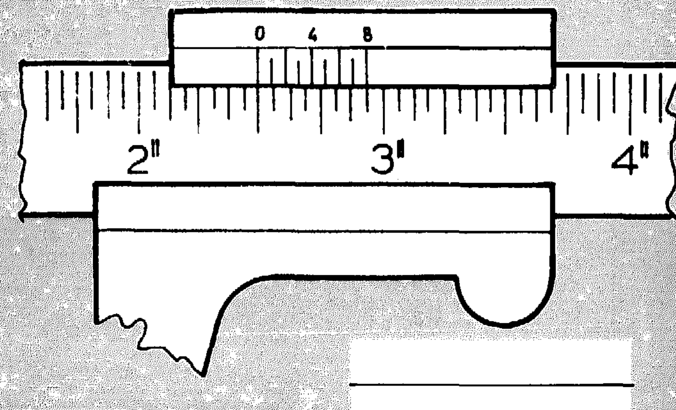


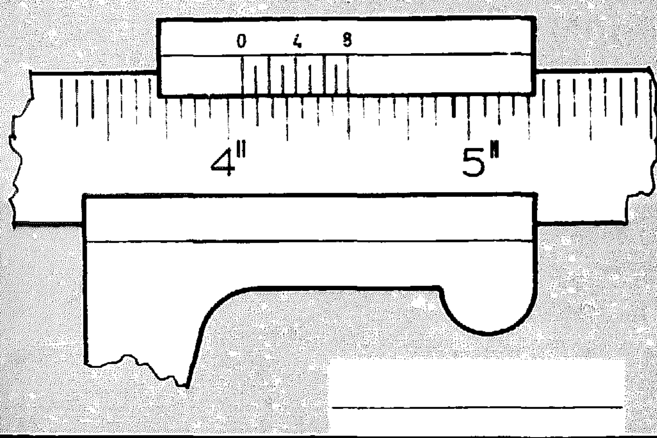
SOME READING EXERCISES WITH METRIC SCALES ACCURATE TO WITHIN 0.1 mm.

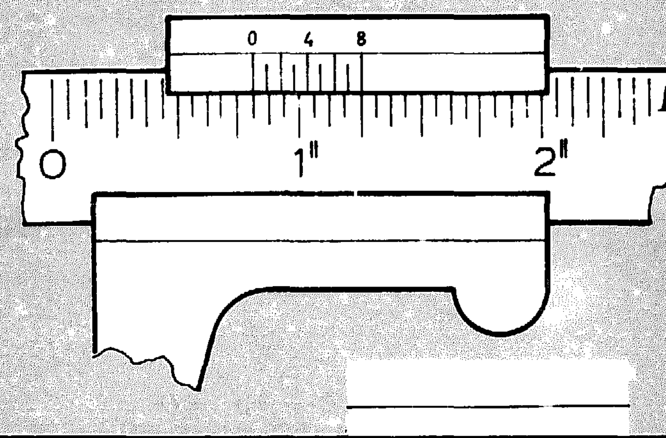


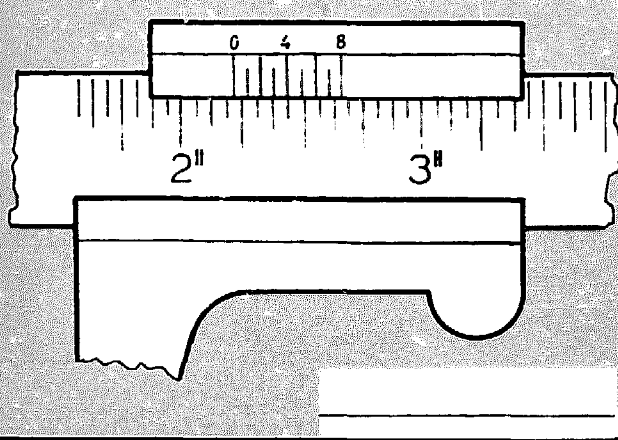
SOME EXERCISES WITH INCH SCALES ACCURATE TO WITHIN 1/128 inch.

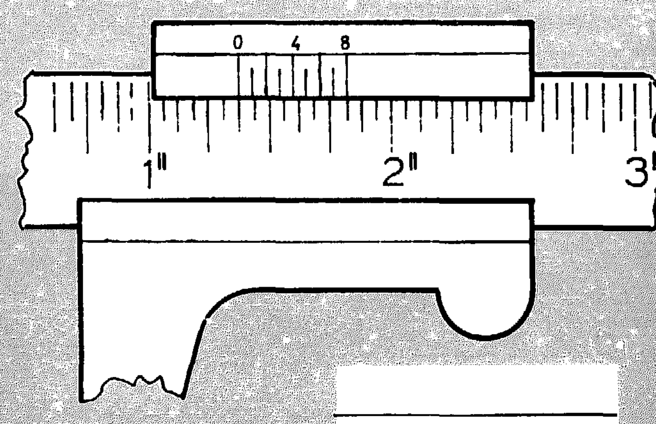


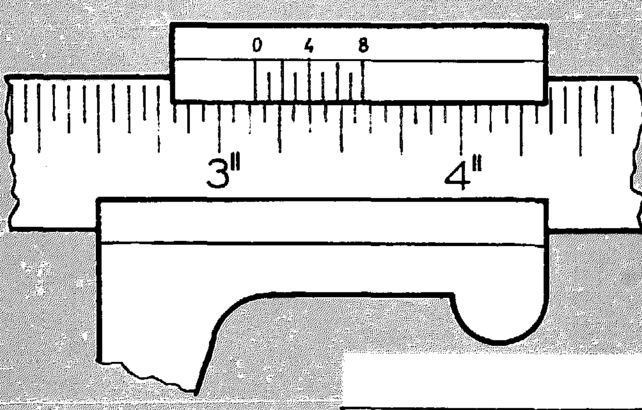


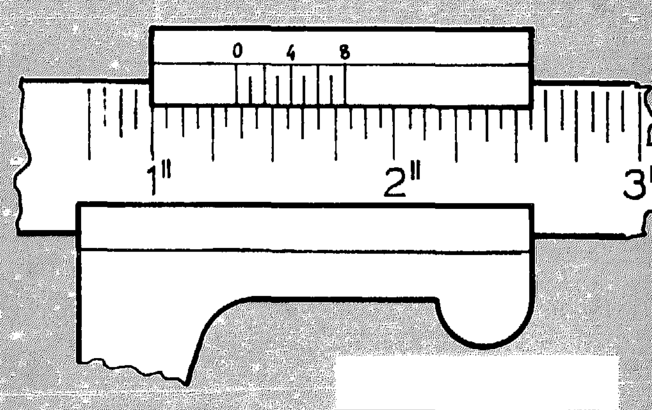




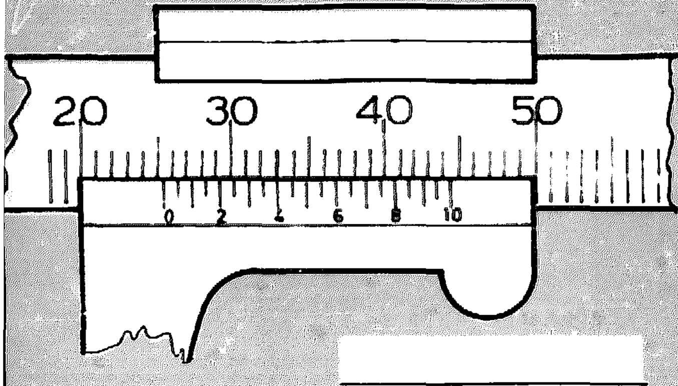


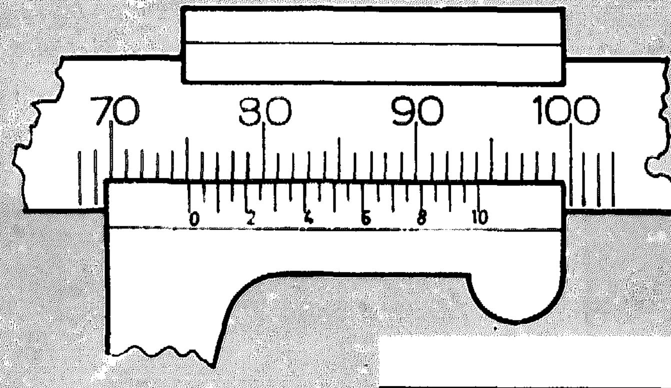


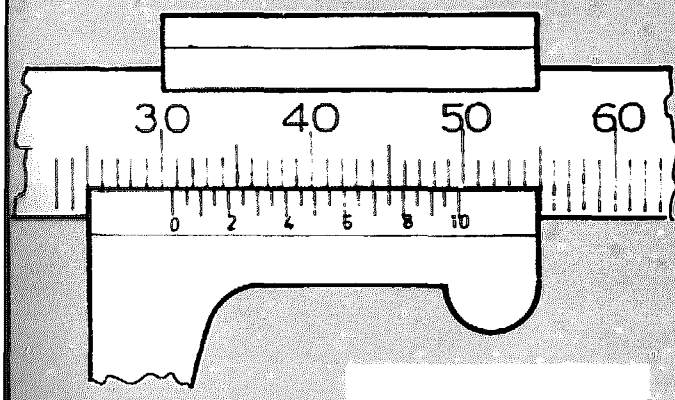


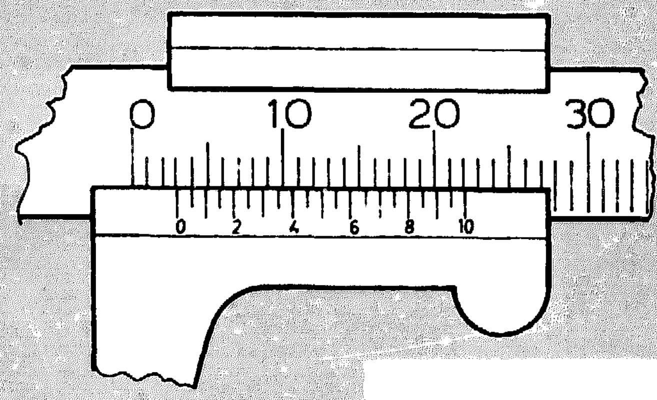


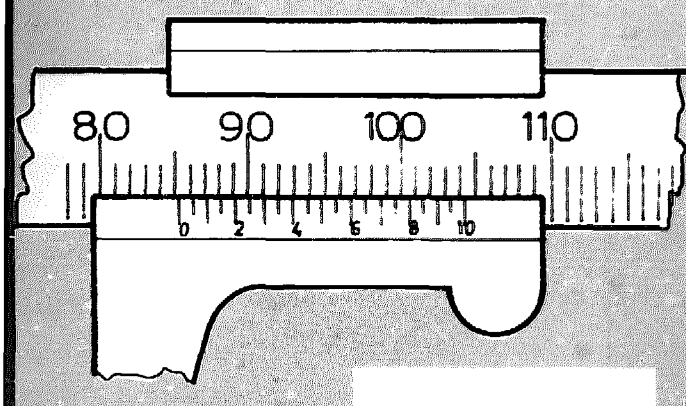
SOME EXERCISES WITH METRIC SCALES ACCURATE TO WITHIN 0.05 mm.

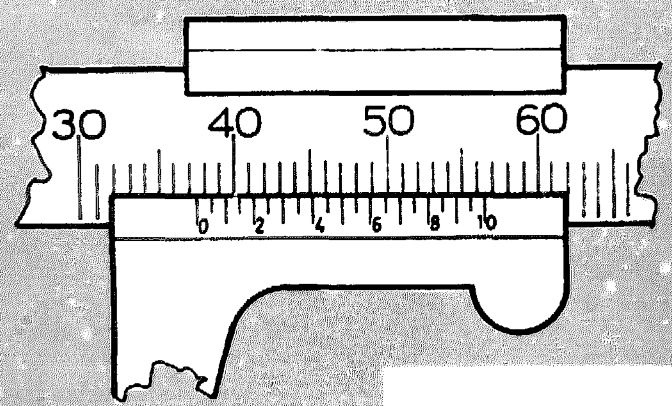


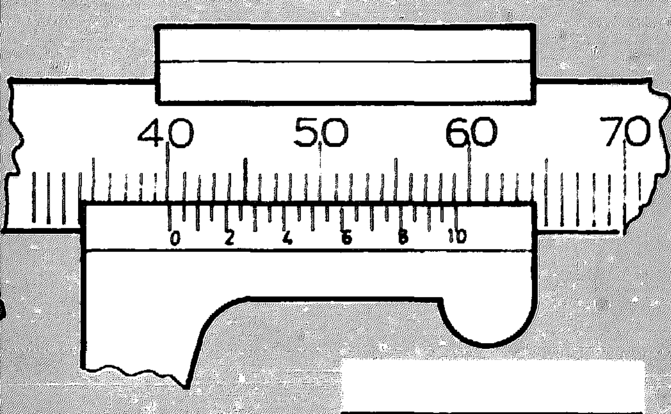


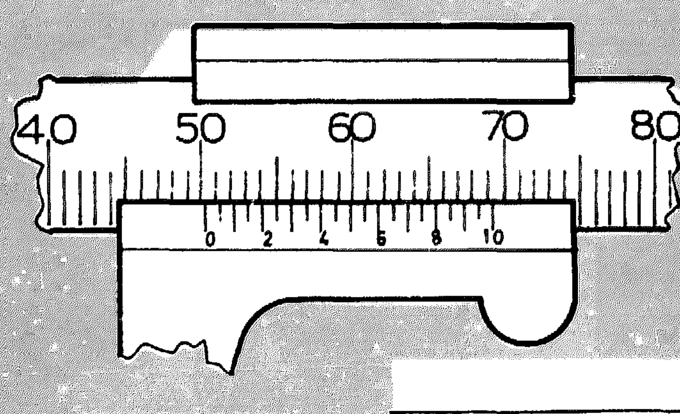




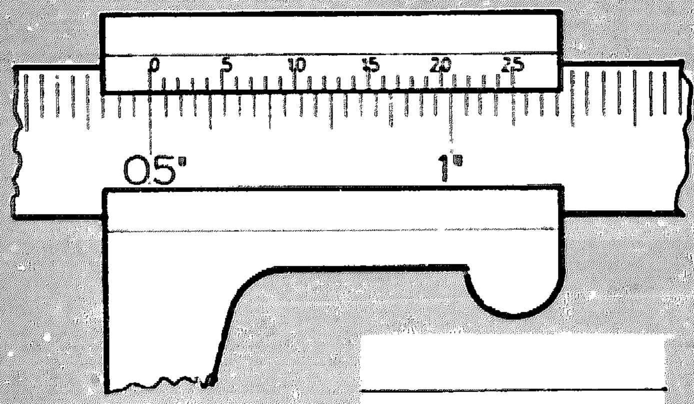


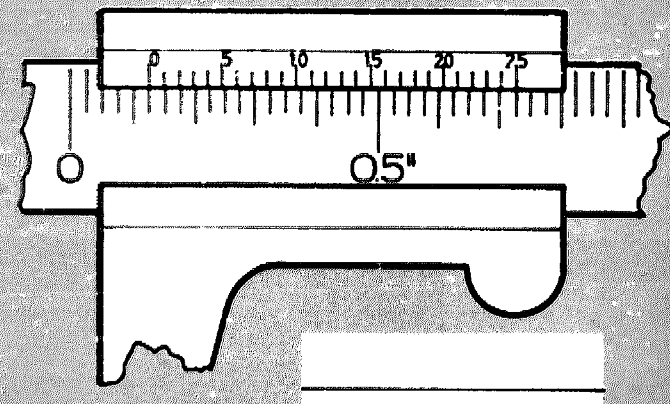


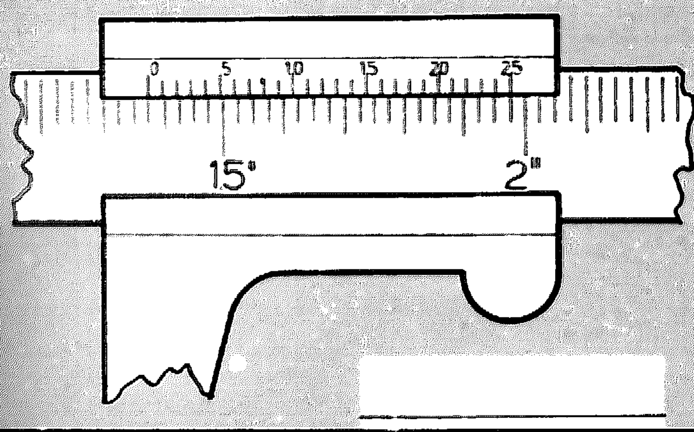


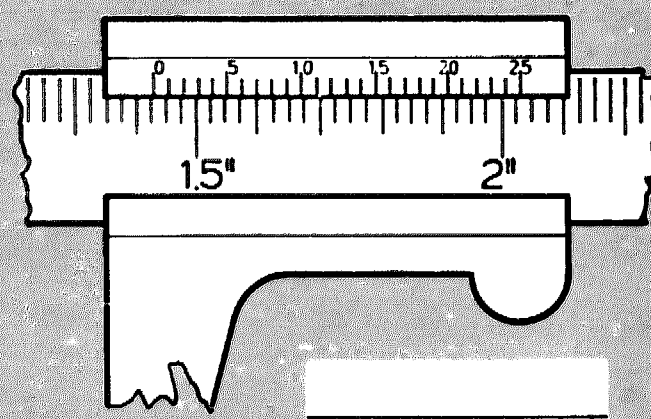


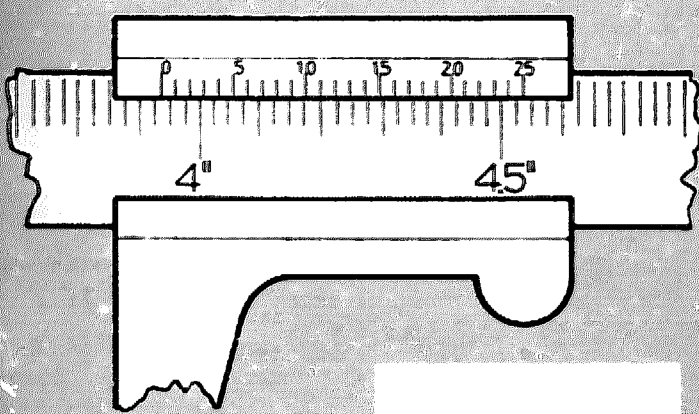
SOME EXERCISES WITH INCH SCALES ACCURATE TO WITHIN 0.001 inch.

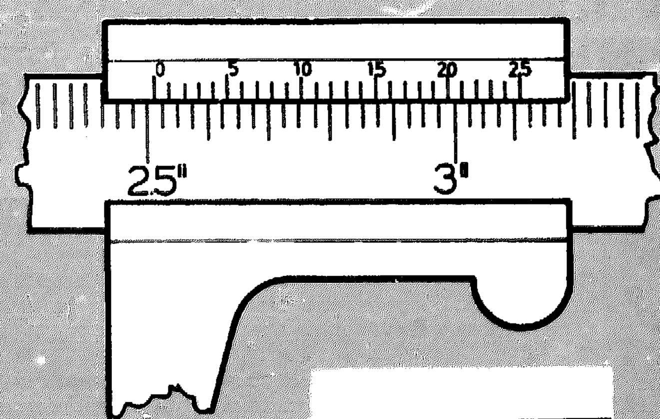


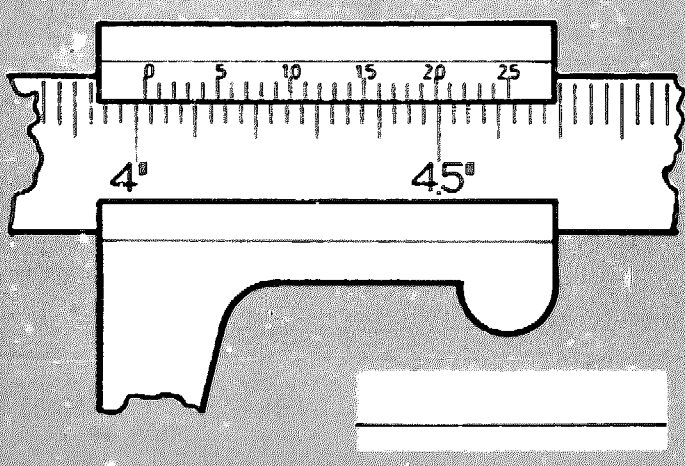












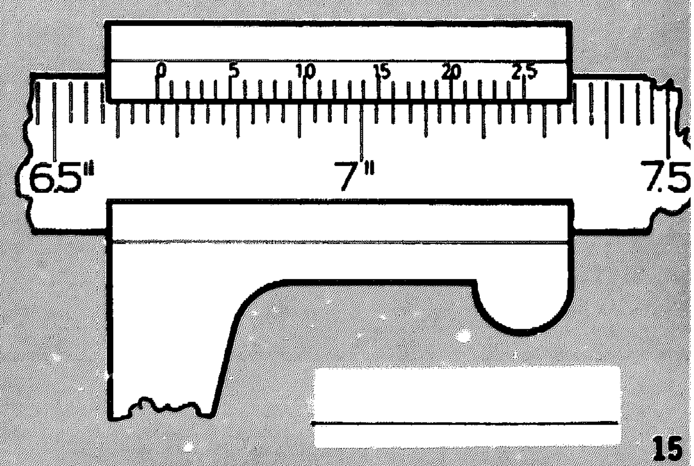


TABLE FOR CONVERTING INCH SCALES INTO METRIC SCALES.

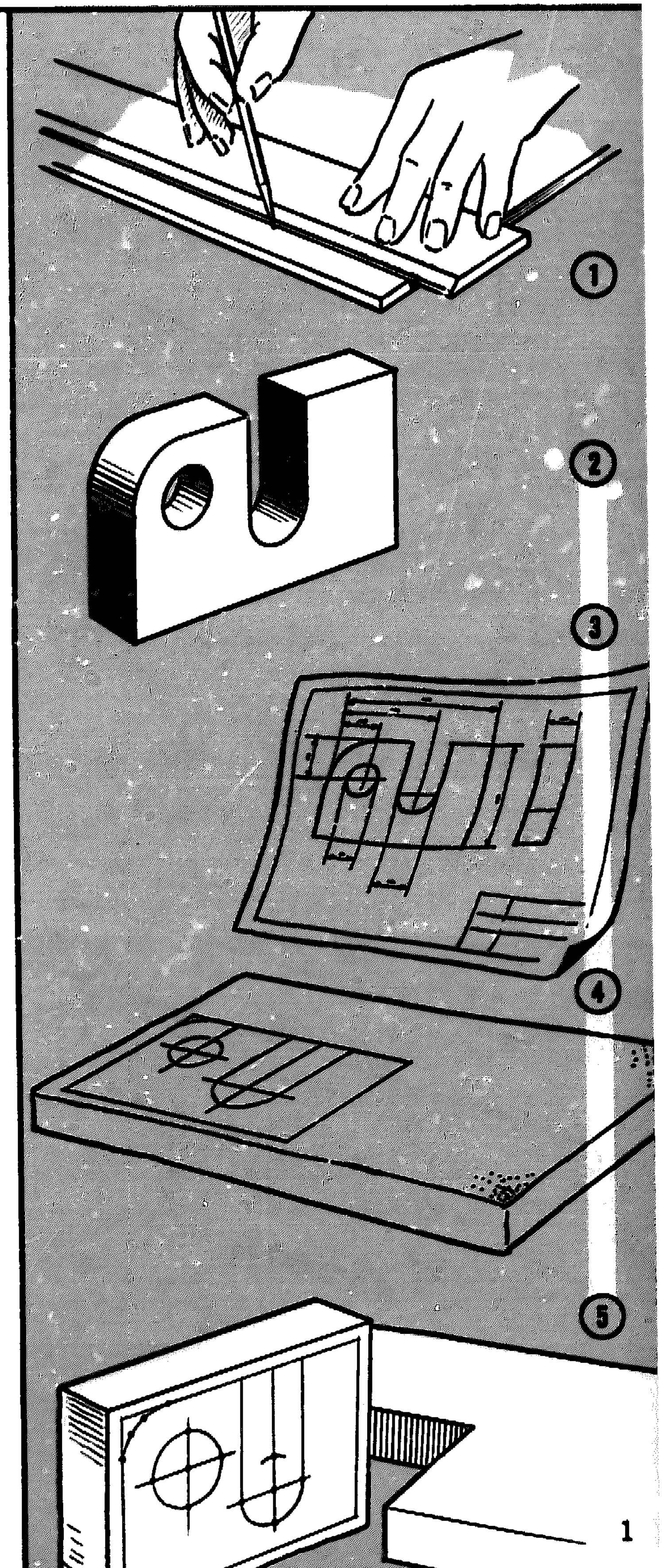
Sub-divisions of 1"		0" mm	1" mm	2" mm	3" mm	4" mm	5" mm	6" mm	7" mm	8" mm	9" mm	10" mm	11" mm
0	0	0	25.400 0	50.800 0	76.200 0	101.600 0	127.000 0	152.400 0	177.800 0	203.200 0	228.600 0	254.000 0	279.400 0
1/64	0.015 625	0.396 9	25.796 9	51.196 9	76.596 9	101.996 9	127.396 9	152.796 9	178.196 9	203.596 9	228.996 9	254.396 9	279.796 9
1/32	0.031 25	0.793 8	26.193 8	51.593 8	76.993 8	102.393 8	127.793 8	153.193 8	178.593 8	203.993 8	229.393 8	254.793 8	280.193 8
3/64	0.046 875	1.190 6	26.590 6	51.990 6	77.390 6	102.790 6	128.190 6	153.590 6	178.990 6	204.390 6	229.790 6	255.190 6	280.590 6
1/16	0.062 5	1.587 5	26.987 5	52.387 5	77.787 5	103.187 5	128.587 5	153.987 5	179.387 5	204.787 5	230.187 5	255.587 5	280.987 5
5/64	0.078 125	1.984 4	27.384 4	52.784 4	78.184 4	103.584 4	128.984 4	154.384 4	179.784 4	205.184 4	230.584 4	255.984 4	281.384 4
3/32	0.093 75	2.381 2	27.781 2	53.181 2	78.581 2	103.981 2	129.381 2	154.781 2	180.181 2	205.581 2	230.981 2	256.381 2	281.781 2
7/64	0.109 375	2.778 1	28.178 1	53.578 1	78.978 1	104.378 1	129.178 1	155.178 1	180.578 1	205.978 1	231.378 1	256.778 1	282.178 1
1/8	0.125	3.175 0	28.575 0	53.975 0	79.375 0	104.775 0	130.175 0	155.575 0	180.975 0	206.375 0	231.775 0	257.175 0	282.575 0
9/64	0.140 625	3.571 9	28.971 9	54.371 9	79.771 9	105.171 9	130.571 9	155.971 9	181.371 9	206.771 9	232.171 9	257.571 9	282.971 9
5/32	0.156 25	3.968 8	29.368 8	54.786 8	80.168 8	105.568 8	130.968 8	156.368 8	181.768 8	207.168 8	232.568 8	257.968 8	283.368 8
11/64	0.171 875	4.365 6	29.765 6	55.165 6	80.565 6	105.965 6	131.365 6	156.765 6	182.165 6	207.565 6	232.965 6	258.365 6	283.765 6
3/16	0.187 5	4.762 5	30.162 5	55.562 5	80.962 5	106.362 5	131.762 5	157.162 5	182.562 5	207.962 5	233.362 5	258.762 5	284.162 5
13/64	0.203 125	5.159 4	30.559 4	55.959 4	81.359 4	106.759 4	132.159 4	157.559 4	182.959 4	208.359 4	233.759 4	259.159 4	284.559 4
7/32	0.218 75	5.556 2	30.956 2	56.356 2	81.756 2	107.156 2	132.556 2	157.956 2	183.356 2	208.756 2	234.156 2	259.556 2	284.956 2
15/64	0.234 375	5.953 1	31.353 1	56.753 1	82.153 1	107.553 1	132.953 1	158.353 1	183.753 1	209.153 1	234.553 1	259.953 1	285.353 1
1/4	0.25	6.350 0	31.750 0	57.150 0	82.550 0	107.950 0	133.350 0	158.750 0	184.150 0	209.550 0	234.950 0	260.350 0	285.750 0
17/64	0.265 625	6.746 9	32.146 9	57.546 9	82.946 9	108.346 9	133.746 9	159.146 9	184.546 9	209.946 9	235.346 9	260.746 9	286.146 9
9/32	0.281 25	7.143 8	32.543 8	57.943 8	83.343 8	108.743 8	134.143 8	159.543 8	184.943 8	210.343 8	235.743 8	261.143 8	286.143 8
19/64	0.296 875	7.540 6	32.940 6	58.340 6	83.740 6	109.140 6	134.540 6	159.940 6	185.340 6	210.740 6	236.140 6	261.540 6	286.940 6
5/16	0.312 5	7.937 5	33.337 5	58.737 5	84.137 5	109.537 5	134.937 5	160.337 5	185.737 5	211.137 5	236.537 5	261.937 5	287.337 5
21/64	0.328 125	8.334 4	33.734 4	59.134 4	84.534 4	109.934 4	135.334 4	160.734 4	186.134 4	211.534 4	236.934 4	262.334 4	287.734 4
11/32	0.343 75	8.731 2	34.131 2	59.531 2	84.931 2	110.331 2	135.731 2	161.131 2	186.531 2	211.931 2	237.331 2	262.731 2	288.131 2
23/64	0.359 375	9.128 1	34.528 1	59.928 1	85.328 1	110.728 1	136.128 1	161.528 1	186.928 1	212.328 1	237.728 1	263.128 1	288.528 1
3/8	0.375	9.525 0	34.925 0	60.325 0	85.725 0	111.125 0	136.525 0	161.925 0	187.325 0	212.725 0	238.125 0	263.525 0	288.925 0
25/64	0.390 625	9.921 9	35.321 9	60.721 9	86.121 9	111.521 9	136.921 9	162.321 9	187.721 9	213.121 9	238.521 9	263.921 9	289.321 9
13/32	0.406 25	10.318 8	35.718 8	61.118 8	86.518 8	111.918 8	137.318 8	162.718 8	188.118 8	213.518 8	238.918 8	264.318 8	289.718 8
27/64	0.421 875	10.715 6	36.115 6	61.515 6	86.915 6	112.315 6	137.715 6	163.115 6	188.515 6	213.915 6	239.315 6	264.715 6	290.115 6
7/16	0.437 5	11.112 5	36.512 5	61.912 5	87.312 5	112.712 5	138.112 5	163.512 5	188.912 5	214.312 5	239.712 5	265.112 5	290.512 5
29/64	0.453 125	11.509 4	36.909 4	62.309 4	87.709 4	113.109 4	138.509 4	163.909 4	189.309 4	214.709 4	240.109 4	265.509 4	290.909 4
15/32	0.468 75	11.906 2	37.306 2	62.706 2	88.106 2	113.506 2	138.906 2	164.306 2	189.706 2	215.106 2	240.506 2	265.906 2	291.306 2
31/64	0.484 375	12.303 1	37.703 1	63.103 1	88.503 1	113.903 1	139.303 1	164.703 1	190.103 1	215.503 1	240.903 1	266.303 1	291.703 1
1/2	0.5	12.700 0	38.100 0	63.500 0	88.900 0	114.300 0	139.700 0	165.100 0	190.500 0	215.900 0	241.300 0	266.700 0	292.100 0
33/64	0.515 625	13.096 9	38.496 9	63.896 9	89.296 9	114.696 6	140.096 9	165.496 9	190.896 9	216.296 9	241.696 9	267.096 9	292.496 9
17/32	0.531 25	13.493 8	38.893 8	64.293 8	89.693 8	115.093 8	140.493 8	165.893 8	191.293 8	216.693 8	242.093 8	267.493 8	292.893 8
35/64	0.546 875	13.890 6	39.290 6	64.690 6	90.090 6	115.490 6	140.890 6	166.290 6	191.690 6	217.090 6	242.490 6	267.890 6	293.290 6
9/16	0.562 5	14.287 5	39.687 5	65.087 5	90.487 5	115.887 5	141.287 5	166.687 5	192.087 5	217.487 5	242.887 5	268.287 5	293.687 5
37/64	0.578 125	14.684 4	40.084 4	65.484 4	90.884 4	116.284 4	141.684 4	167.084 4	192.484 4	217.884 4	243.284 4	268.684 4	294.084 4
19/32	0.593 75	15.081 2	40.481 2	65.881 2	91.281 2	116.681 2	142.081 2	167.481 2	192.881 2	218.281 2	243.681 2	269.081 2	294.481 2
39/64	0.609 375	15.478 1	40.878 1	66.278 1	91.678 1	117.078 1	142.478 1	167.878 1	193.278 1	218.678 1	244.078 1	269.478 1	294.878 1
5/8	0.625	15.875 0	41.275 0	66.675 0	92.075 0	117.475 0	142.875 0	168.275 0	193.675 0	219.075 0	244.475 0	269.875 0	295.275 0
41/64	0.640 625	16.271 9	41.671 9	67.071 9	92.471 9	117.871 9	143.271 9	168.671 9	194.071 9	219.471 9	244.871 9	270.271 9	295.671 9
21/32	0.656 25	16.668 8	42.068 8	67.468 8	92.868 8	118.268 8	143.668 8	169.068 8	194.468 8	219.868 8	245.268 8	270.668 8	296.068 8
43/64	0.671 875	17.065 6	42.465 6	67.865 6	93.265 6	118.665 6	144.065 6	169.465 6	194.865 6	220.265 6	245.665 6	271.065 6	296.465 6
11/16	0.687 5	17.462 5	42.862 5	68.262 5	93.662 5	119.062 5	144.462 5	169.862 5	195.262 5	220.662 5	246.062 5	271.462 5	296.862 5
45/64	0.703 125	17.859 4	43.259 4	68.659 4	94.059 4	119.459 4	144.859 4	170.259 4	195.659 4	221.059 4	246.459 4	271.859 4	297.259 4
23/32	0.718 75	18.256 2	43.656 2	69.056 2	94.456 2	119.856 2	145.256 2	170.656 2	196.056 2	221.456 2	246.856 2	272.256 2	297.656 2
47/64	0.734 375	18.653 1	44.053 1	69.453 1	94.853 1	120.253 1	145.653 1	171.053 1	196.453 1	221.853 1	247.253 1	272.653 1	298.053 1
3/4	0.75	19.050 0	44.450 0	69.850 0	95.250 0	120.650 0	146.050 0	171.450 0	196.850 0	222.250 0	247.650 0	273.050 0	298.450 0
49/64	0.765 625	19.446 9	44.846 9	70.246 9	95.646 9	121.046 9	146.446 9	171.846 9	197.246 9	222.646 9	248.046 9	273.446 9	298.846 9
25/32	0.781 25	19.843 8	45.243 8	70.643 8	96.043 8	121.443 8	146.843 8	172.243 8	197.643 8	223.043 8	248.443 8	273.843 8	299.243 8
51/64	0.796 875	20.240 6	45.640 6	71.040 6	96.440 6	121.840 6	147.240 6	172.640 6	198.040 6	223.440 6	248.840 6	274.240 6	299.640 6
13/16	0.812 5	20.637 5	46.037 5	71.437 5	96.837 5	122.237 5	147.637 5	173.037 5	198.437 5	223.837 5	249.237 5	274.637 5	300.037 5
53/64	0.828 125	21.034 4	46.434 4	71.834 4	97.234 4	122.634 4	148.034 4	173.434 4	198.834 4	224.234 4	249.634 4	275.034 4	300.434 4
27/32	0.843 75	21.431 2	46.831 2	72.231 2	97.631 2	123.031 2	148.431 2	173.831 2	199.231 2	224.631 2	250.031 2	275.431 2	300.831 2
55/64	0.859 375	21.828 1	47.228 1	72.623 1	98.028 1	123.428 1	148.828 1	174.228 1	199.628 1	225.028 1	250.428 1	275.828 1	301.228 1
7/8	0.875	22.225 0	47.625 0	73.025 0	98.425 0	123.825 0	149.225 0	174.625 0	200.025 0	225.425 0	250.825 0	276.225 0	301.625 0
57/64	0.890 625	22.621 9	48.021 9	73.421 9	98.821 9	124.221 9	149.621 9	175.021 9	200.421 9	225.821 9	251.221 9	276.621 9	302.021 9
29/32	0.906 25	23.018 8	48.418 8	73.818 8	99.218 8	124.618 8	150.018 8	175.418 8	200.818 8	226.218 8	251.618 8	277.018 8	302.418 8
59/64	0.921 875	23.415 6	48.815 6	74.215 6	99.615 6	125.015 6	150.415 6	175.815 6	201.215 6	226.615 6	252.015 6	277.415 6	302.815 6
15/16	0.937 5	23.812 5	49.212 5	74.612 5	100.012 5	125.412 5	150.812 5	176.212 5	201.612 5	227.012 5	252.412 5	277.812 5	303.212 5
61/64	0.953 125	24.209 4	49.609 4	75.009 4	100.409 4	125.809 4	151.209 4	176.609 4	202.009 4	227.409 4	252.809 4	278.209 4	303.609 4
31/32	0.968 75	24.606 2	50.006 2	75.406 2	100.806 2	126.206 2	151.606 2	177.006 2	202.406 2	227.806 2	253.206 2	278.606 2	304.006 2
63/64	0.984 375	25.003 1	50.403 1	75.8031	101.203 1	126.603 1	152.003 1	177.403 1	202.803 1	228.203 1	253.603 1	279.003 1	304.403 1

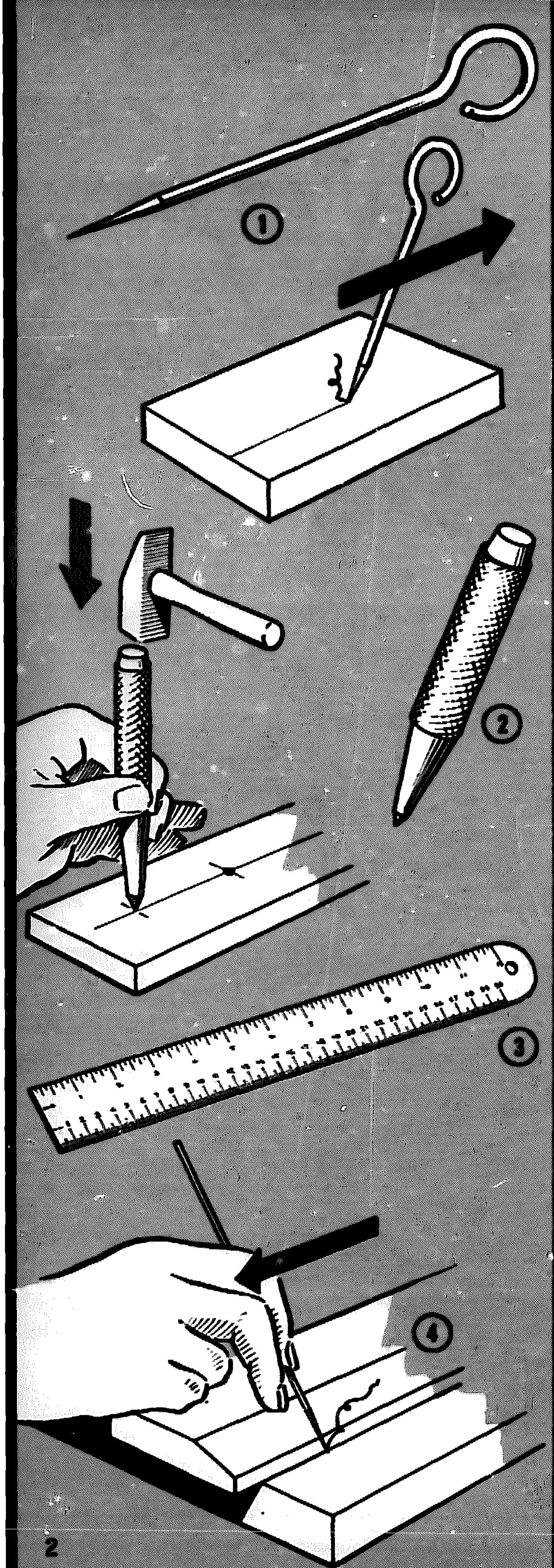
ISBN 90 217 1011 0 MEASURING 1

INTEMS PICTORIAL SYSTEM

MARKING OUT 1

Marking out means marking on the material all the lines and points we need to produce work from it.	1 Marking out
Suppose the item shown here has to be made.	2 Workpiece
First we require a dimensioned drawing, that is a drawing showing the exact shape with all dimensions indicated.	3 Drawing
Next we take a piece of material and accurately copy onto it the shape of the work from the drawing.	4 Material
The last preliminary step is to cut out the piece of material (the blank) with the work marked out on it, leaving it slightly larger than its greatest length and width.	5 Result





1
Scriber

Lines that need not or must not be removed are scratched on the material with the sharp point of a scriber.

2
Centre punch

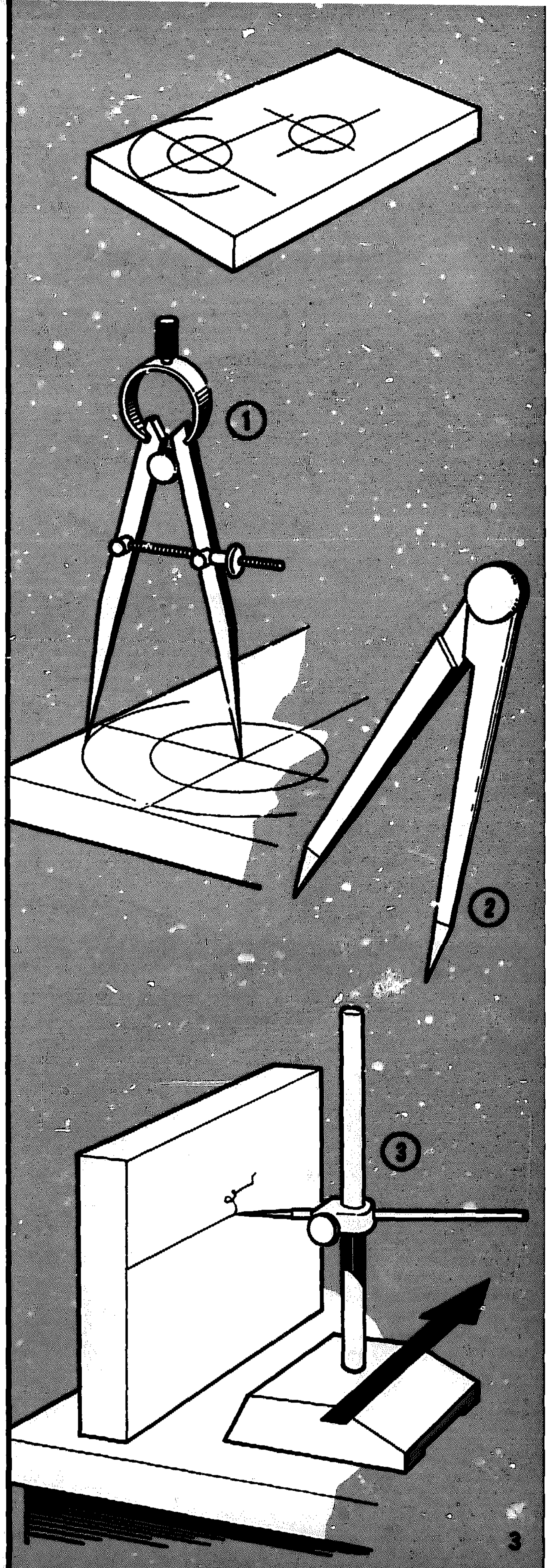
A centre punch is used for marking hole centres. (Without this the drill would twist away).
The centre punch is also used for marking dots along a line before filing or cutting (dot punching). In this way lines are made more visible. Punched dots should be lighter than punched centres and a special dot punch is often used for it.

3
Steel rule

A steel rule is used for measuring and marking off lengths.

4
Straight-edge

Straight, sharp lines are scribed along a steel straight-edge.

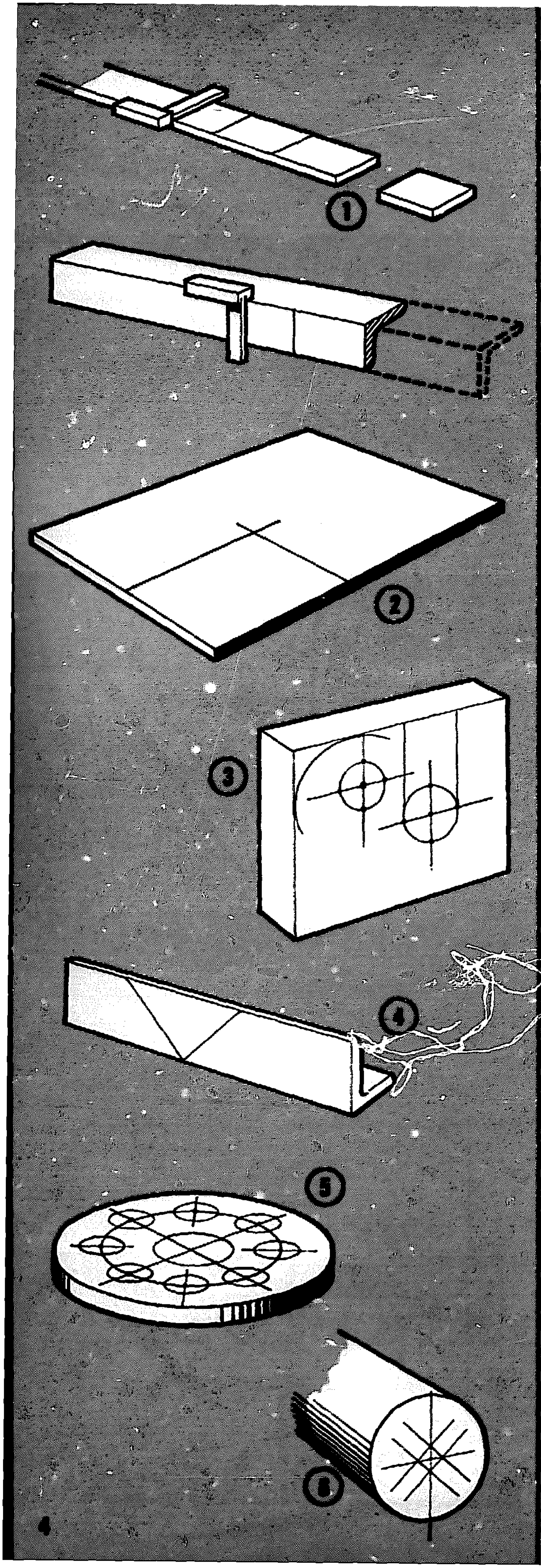


1 and 2
Dividers

Dividers are used for scribing circles and arcs, and for transferring and stepping off distances.

3
The use of a scribing block

For scribing straight lines the scribing block may also be used. It is moved along a flat surface very accurately finished, called a surface plate. The scribing block is also called a surface gauge, especially when both the pillar and the scriber are adjustable to various angles.



Marking out is used for the following purposes:

1. Cutting off bars.

2. Cutting out from sheets and plates.

3. Blanks for initial or further operations.

4. Cutting bevelled angles.

5. Pitch circles for holes that have to be drilled.

6. Centre finding.

Methods of making lines visible on materials.

1 Scratching

Lines may be scratched into materials by means of a hard scriber.

2 Drawing

With a soft scriber or a pencil it is possible to draw lines on the material. Such lines do not stand out so sharply.

3 Coating

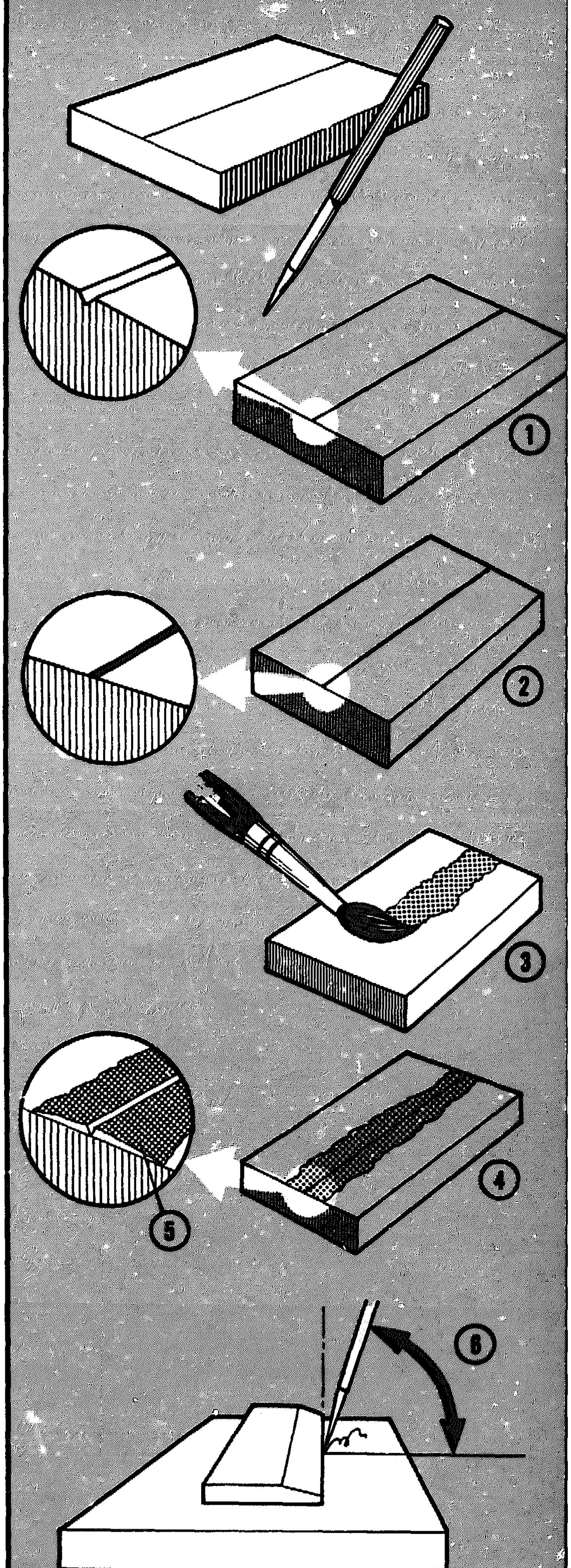
A further possibility is to coat the material with chalk or varnish before scribing.

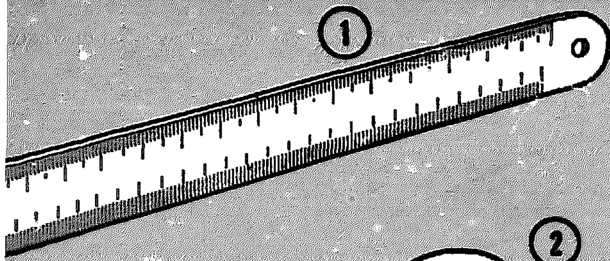
4 and 5 Line in coating

5

6 Scribing along a straight-edge

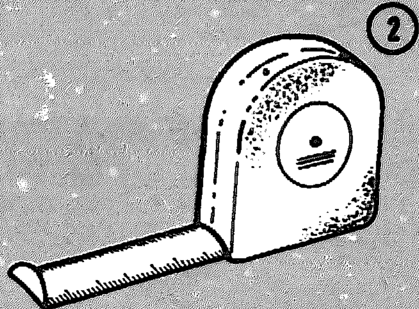
Hold the scriber at an angle in order to get into the corner when scribing along a straight-edge. In this way a sharp line is obtained.



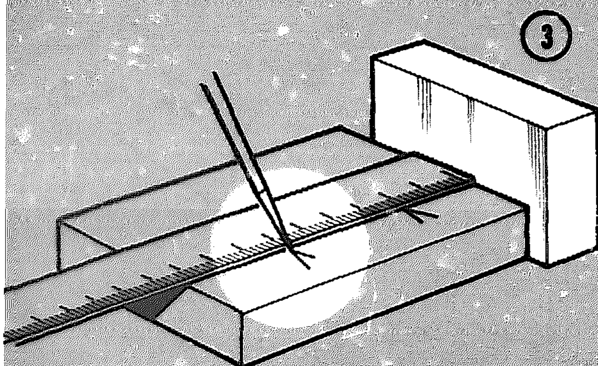


1
Rule

For setting out lengths, a rule or a metal measuring tape is used.

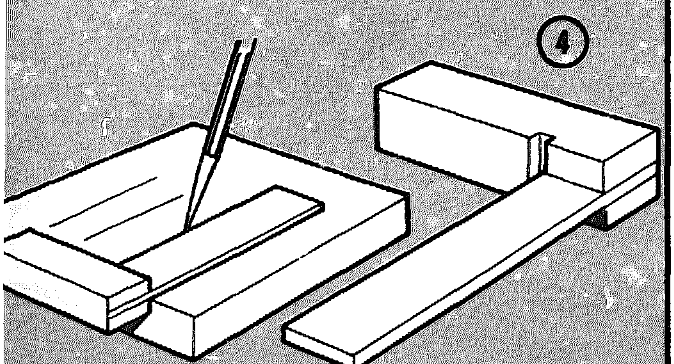


2
Measuring tape



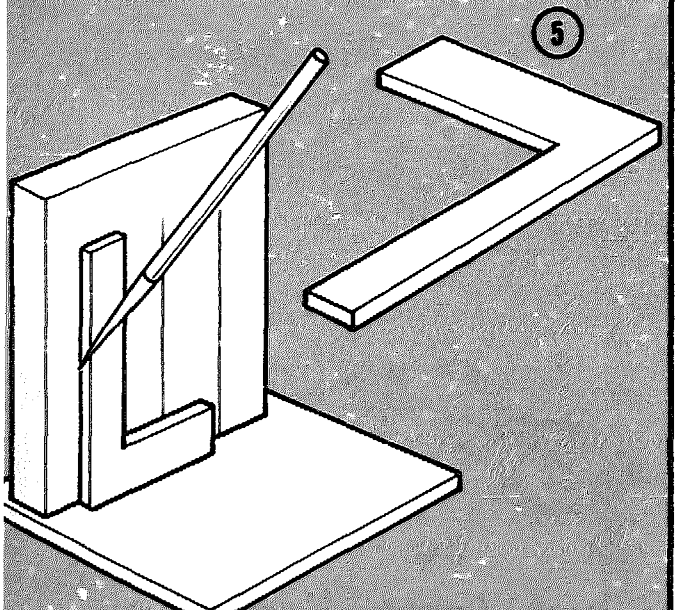
3
Stop block

Whenever possible use a stop block with a rule. Put V-mark exactly at division required.



4
Try square

For squaring and for lines at right angles, a try square or flat L-square is used.



5
Flat L-square

There are various types of dividers.
They are used for transferring distances and scribing circles and arcs.

If a measured length must be transferred the dividers are set with aid of a rule.

1
Using dividers with a rule

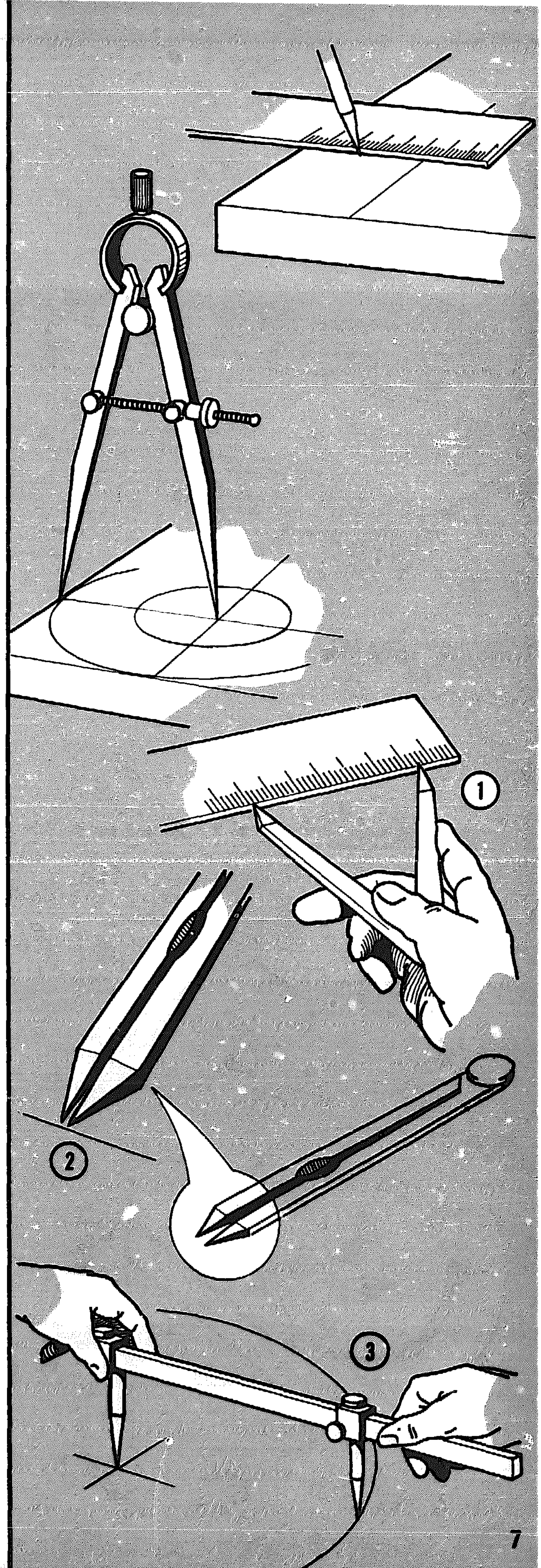
Points should always be well sharpened.

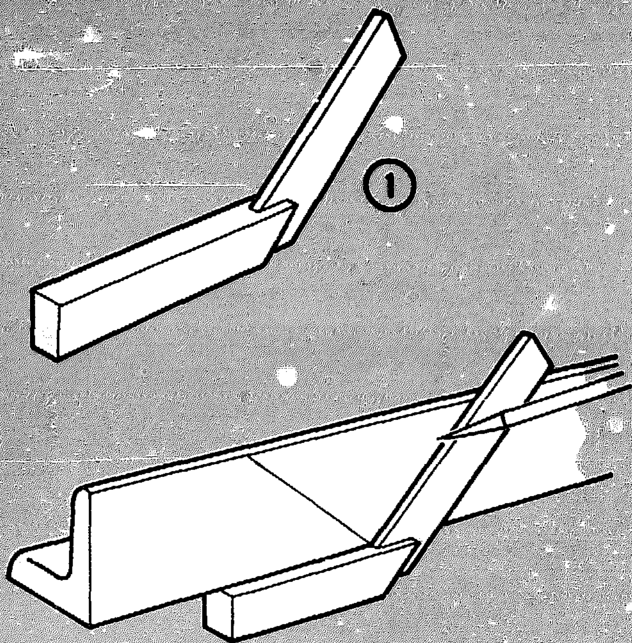
The legs of dividers must be of equal length.

2
Lengths of legs

For large circles beam compasses (also called trammels) are used.

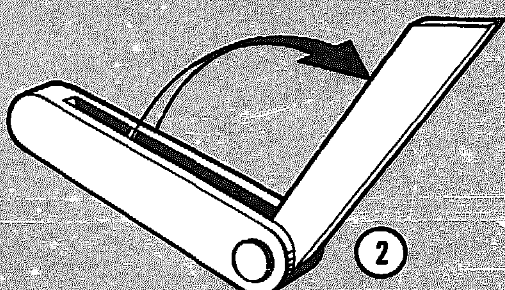
3
Beam compasses (trammels)





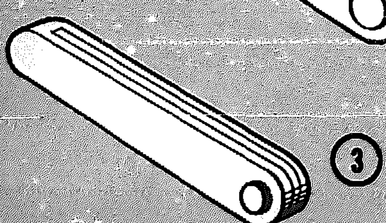
1
Bevel

For marking angles a bevel (also called a mitre square) is used. Fixed bevels may have angles of 60, 30 or 45 degrees.

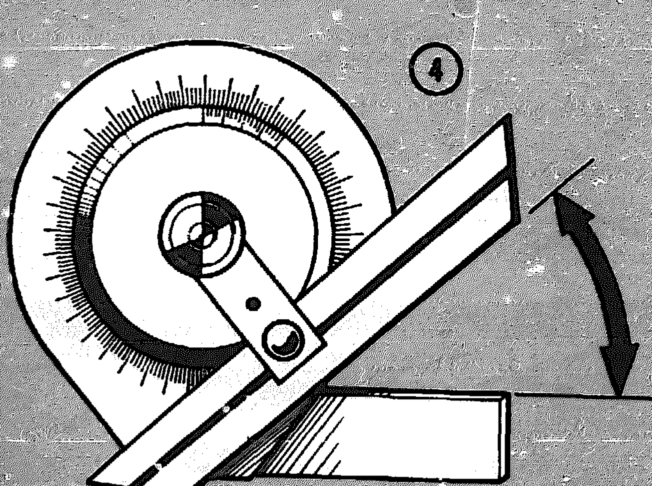


2
Sliding bevel

Sliding bevels may be set to any angle.



3
Sliding bevel (closed)

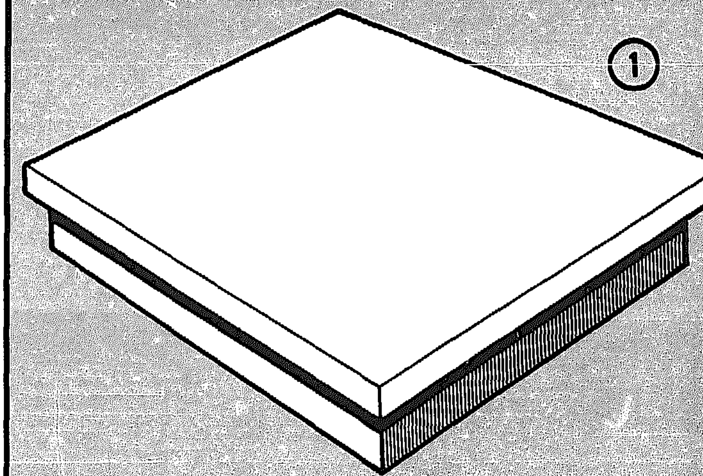


4
Bevel protractor

The same applies to the bevel protractor. It has a graduated or vernier scale by which any angle may be accurately set.

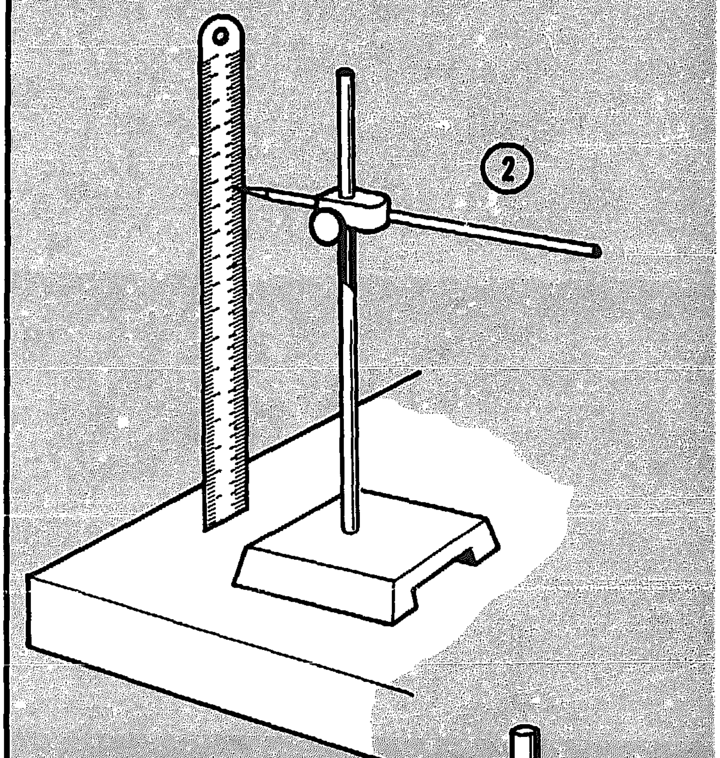
For marking out, a surface plate is often used.
This is a plate with a flat surface of great accuracy that is used for testing the flatness of other surfaces and - together with other instruments - for measuring, testing and marking out purposes.

1
Surface plate



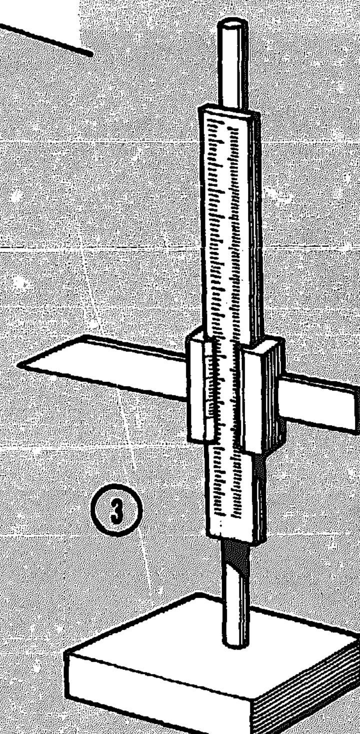
One of the instruments used together with a surface plate is the scribing block. The height of the scriber in the block may be set with the aid of a rule.

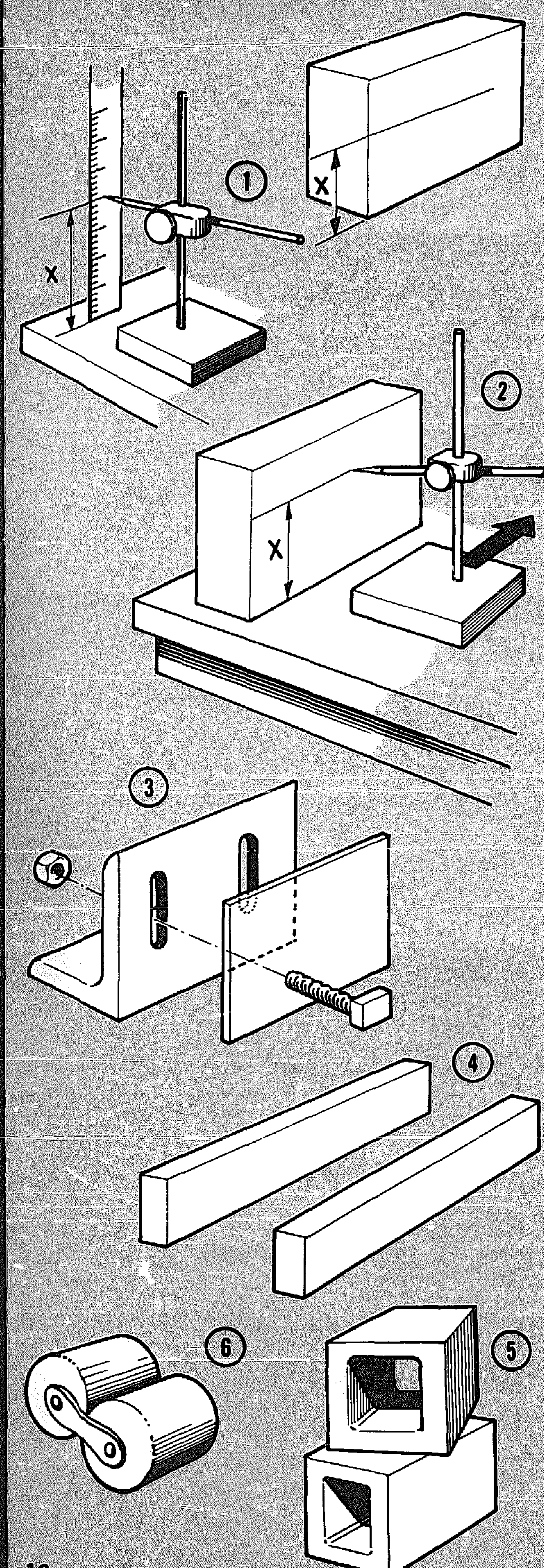
2
Scribing block



If a vertical scale is attached to the pillar of the scribing block, the latter is called a height gauge.

3
Height gauge





1
Setting the scribing block

For marking-out operations the scribing block is used in the following way. Suppose a line is to be marked at a height of 4 cm on the face of a metal block.

1. With the aid of a rule or the scale, the point of the scriber is set to a height of 4 cm above the surface plate. The point should be as near the pillar as possible.

2
Scribing

2. The work is then placed on the surface plate with the point of the scriber touching its face. The scribing block is moved across the surface plate, scribing a line on the work.

3
Angle plate

If the shape of the work will not allow a steady base it may be placed against or clamped to an angle plate.

4
Parallels

Other accessories used with a surface plate to support or position the work include parallels, box angles and roller blocks.

5
Box angles

6
Roller blocks

1
V-block

For supporting circular bars etc. V-blocks are used, e.g. in combination with a centre finder to determine the centre of the bar.

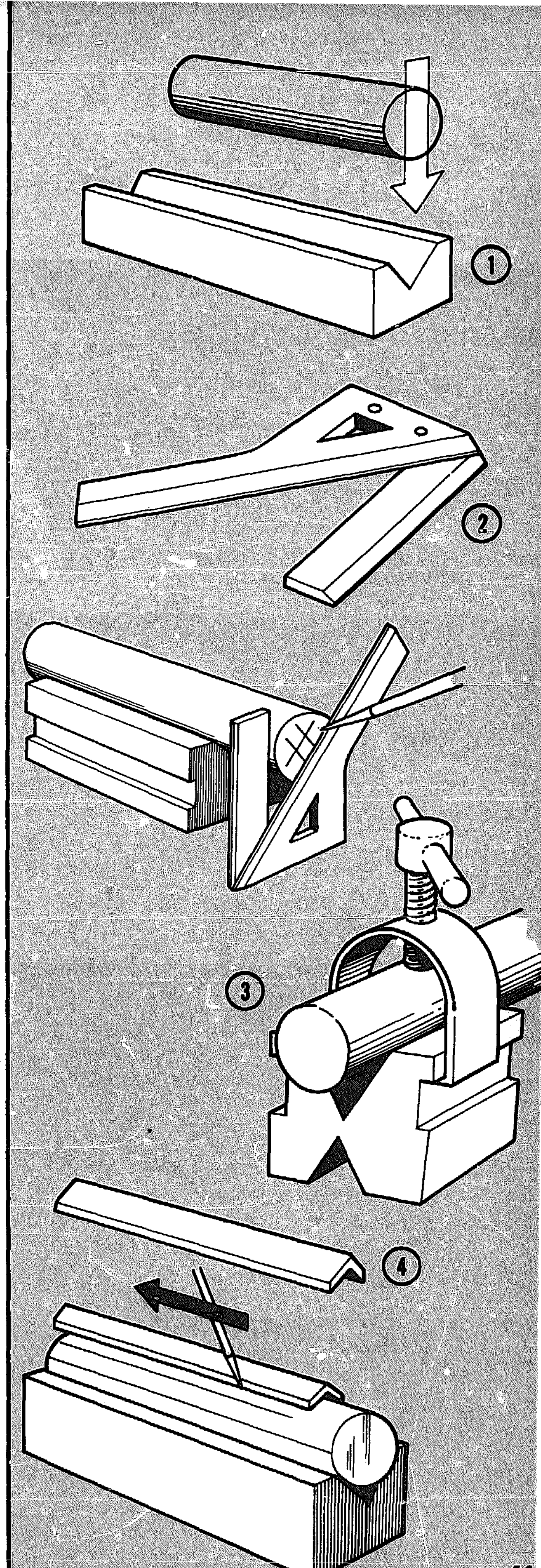
2
Centre finder

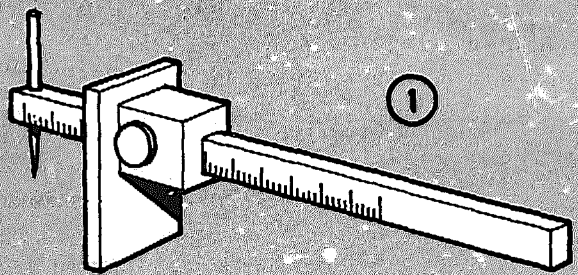
3
Combination V-block and clamp

If necessary the bar can be clamped.

4
Angle bar

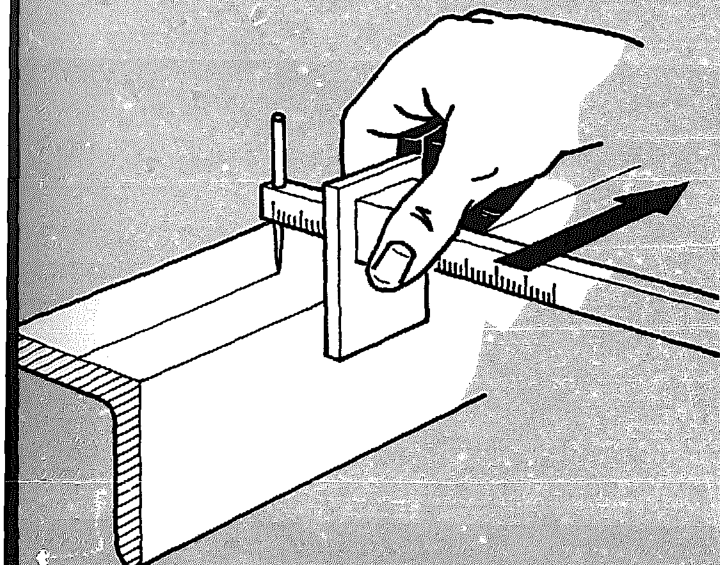
For scribing longitudinal lines on circular bars an angle bar is often used.



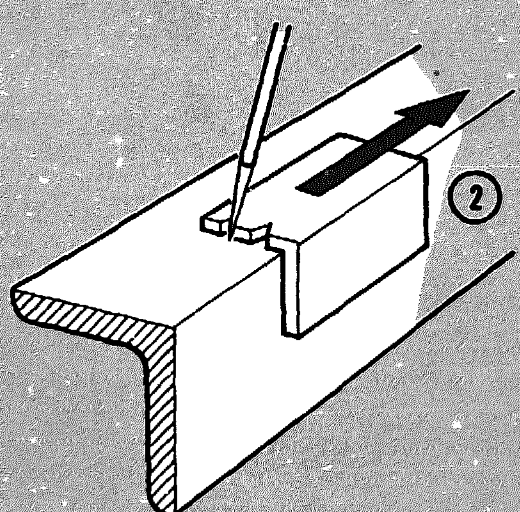


1
Scribing
tool

This scribing tool has a graduated bar with a scriber that slides through the guide block and may be fixed at any distance.



By moving the tool along a channel or angle bar we can scribe a required line.



2
Auxiliary
piece

The same purpose is served by making a small notch in a piece of angle steel, the scriber being inserted in the notch.

Centring of holes is very important. It is done with a centre punch.

1
Centre punch

For locating the centre the punch is held at an angle. When the punch is struck with a hammer it is held upright.

2
At angle for locating

A blow with the hammer on the centre punch produces an indentation in the material.

3
Upright when being struck
4
Before the blow
5
After the blow

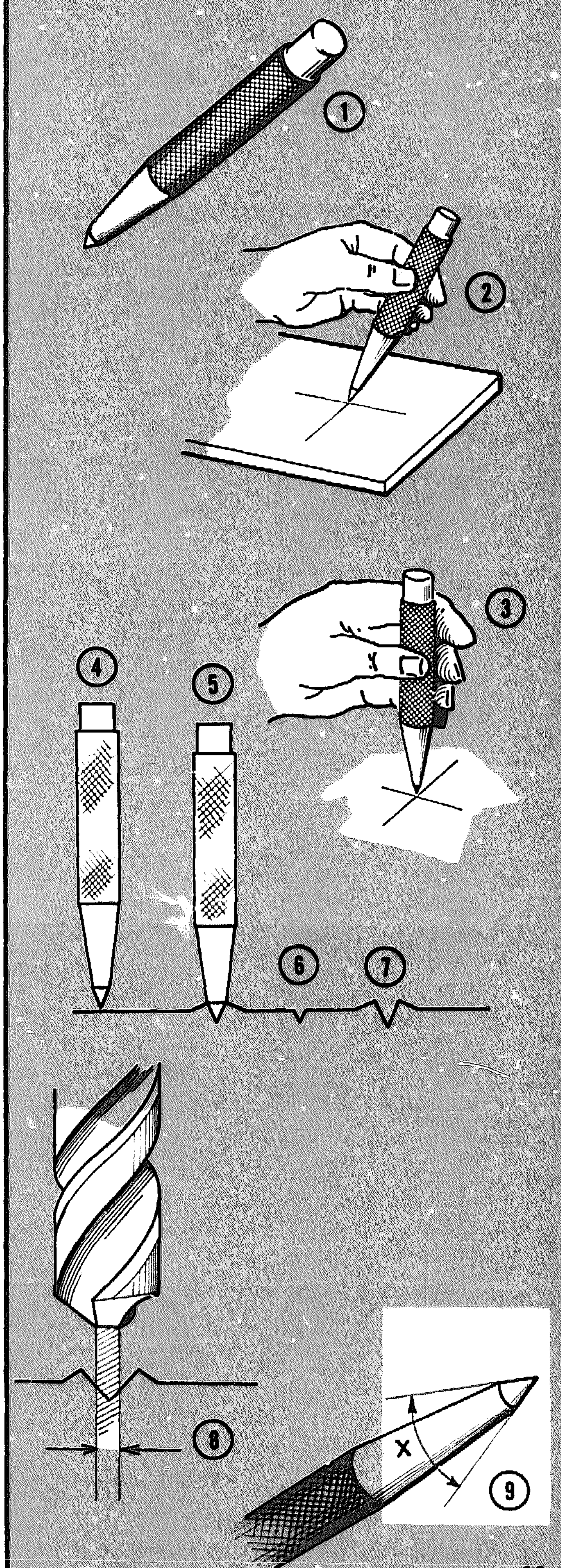
Marking dots are punched in the same way but are lighter than hole centres. A dot punch is often used for this. The diameter of a hole centre should be larger than the core of the drill.

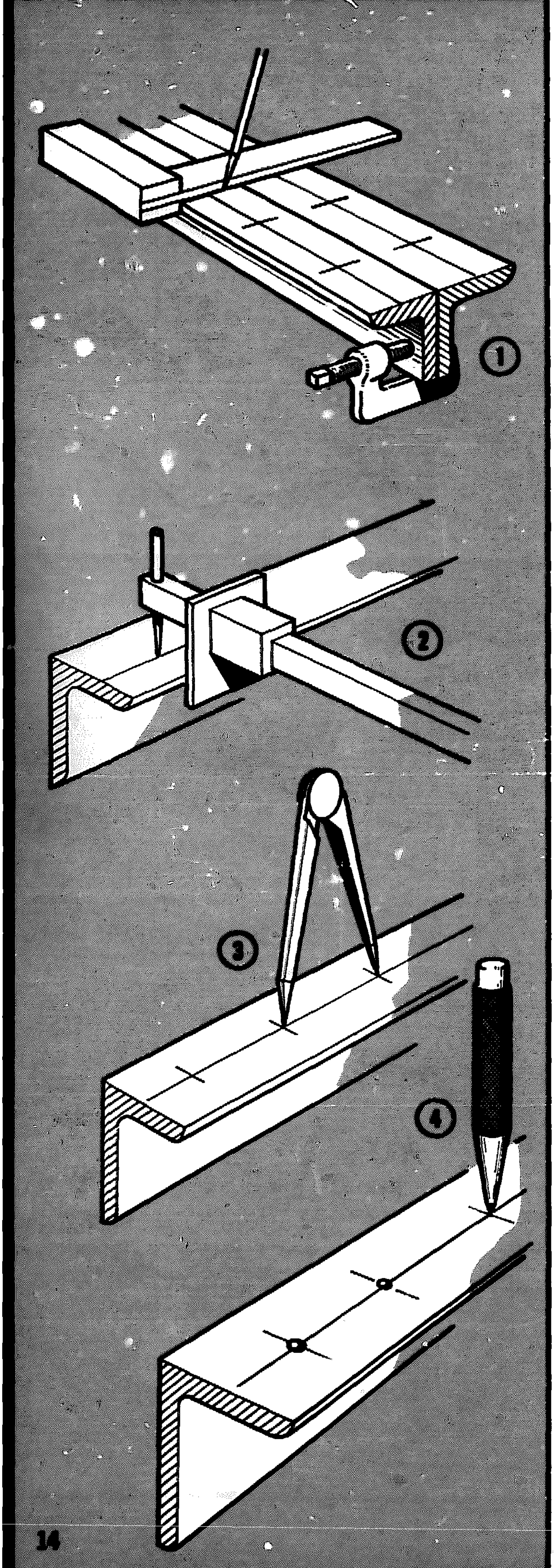
6
Marking dot
7
Hole centre

8
Drill core

The angle at the point of the centre punch should be 55^{o}. It should be resharpened when required.

9
Point of centre punch





1 Clamping

Two equal angle bars on which the same lines are to be scribed may be clamped together.

Holes to be drilled in an angle bar are marked in the following way.

2 Scribing

a. Datum line is scribed.

3 Pitch

b. Equal distances (the pitch) are stepped off with dividers.

4 Centre punching

c. Centres are punched.

MAINTENANCE

Never use a tool for any other purpose than that for which it is meant.

Always clean measuring and marking instruments after use. The surface plate is cleaned with paraffin, then rubbed with acid-free oil on a soft cloth.

Keep the surface plate under a wooden cover lined on the inside with felt strips.

Resharpen centre punches and scribers regularly and to the correct angles. The scriber of a height gauge should be ground on the angle side only.

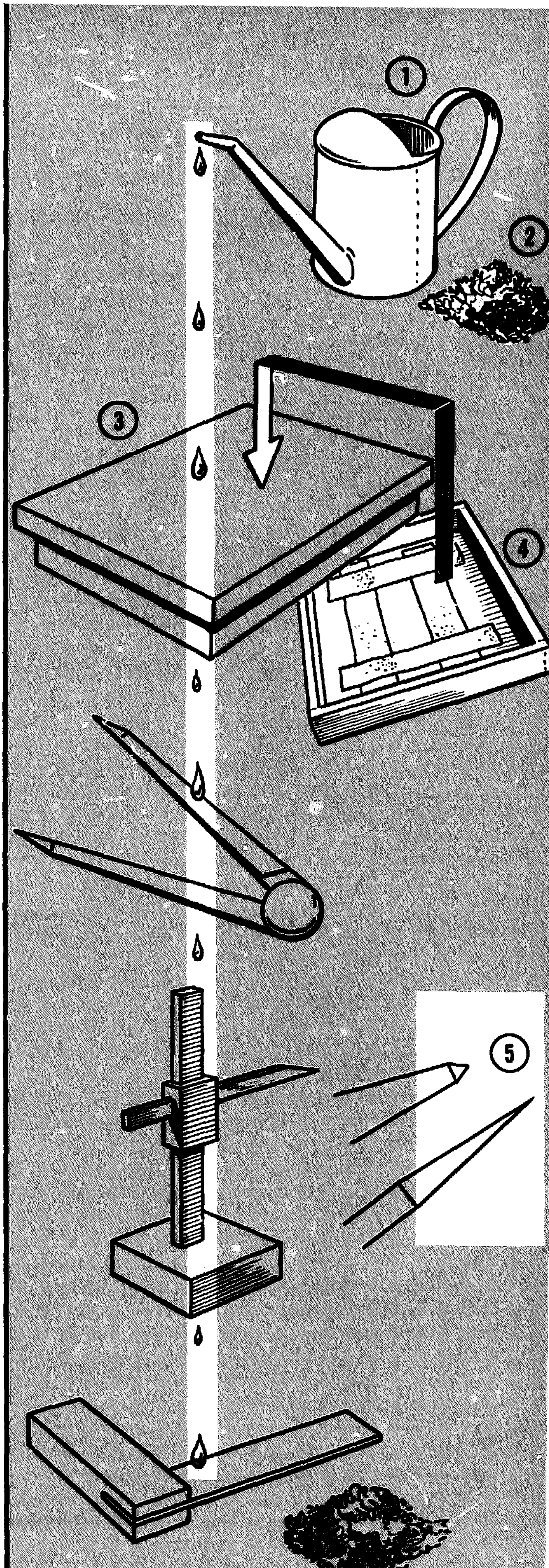
1
Oil can

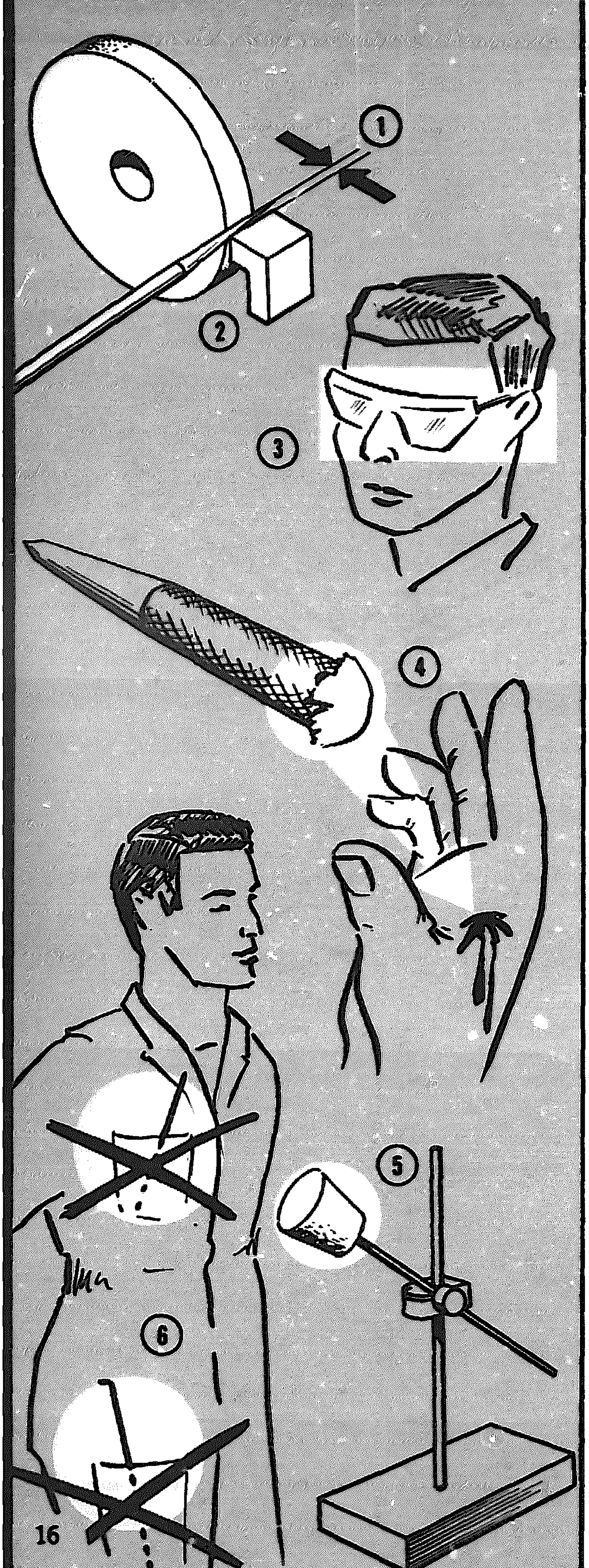
2
Cotton waste

3
Surface plate

4
Cover

5
Points





1 Clearance	Be careful when resharpening scribers.
2 Hand rest	Keep the clearance between hand rest and grinding wheel as small as possible.
3 Goggles	When grinding always use goggles.
4 Burred end	Burred centre punches may cause injuries.
5 Cork	Protect point of scriber with cork.
6 Unsafe	Don't carry sharp scribers in pockets.

ISBN 90 217 1012 9 MARKING OUT 1

INTEMS PICTORIAL SYSTEM

CLAMPING

By clamping is meant holding a work in such a way that it cannot move during an operation.
The method of clamping varies according to the nature of the operation required.
For operation by hand the most commonly used clamping device is the vice.

1
Clamping

On the vice, shown here, we see a solid jaw and a movable jaw.

2
Vice clamps

By means of a spindle and handle the movable jaw may be moved.
The work is clamped between these two jaws.
The distance between the jaws is called the holding width.
The jaws remain parallel, hence the name: parallel vice.

3
Jaw pieces
4
Holding width
5
Width of jaw
6
Anvil
7
Movable jaw
8
Solid jaw

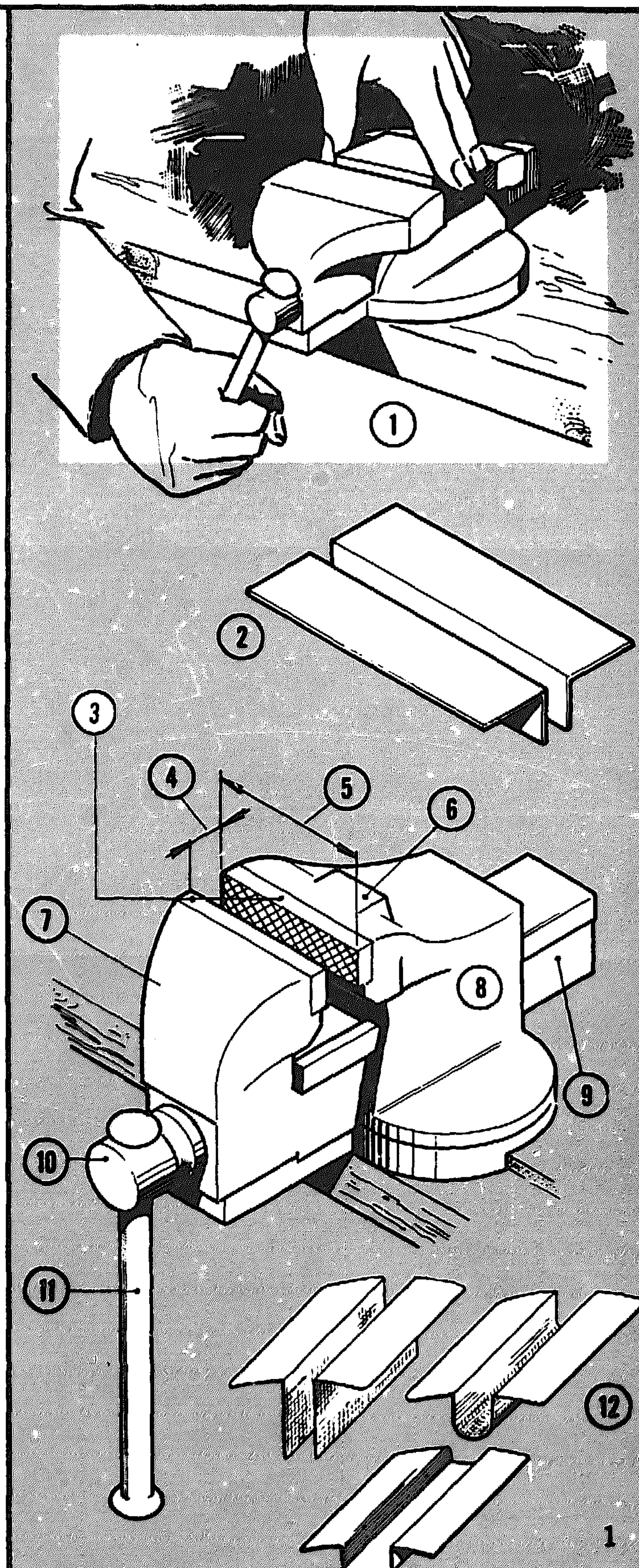
On the jaws are tiny teeth. They might damage the work and therefore vice clamps are often used to protect finished surfaces.
Usually we make the vice clamps ourselves, and we can adapt them to the workpiece.

9
Guide piece
10
Spindle

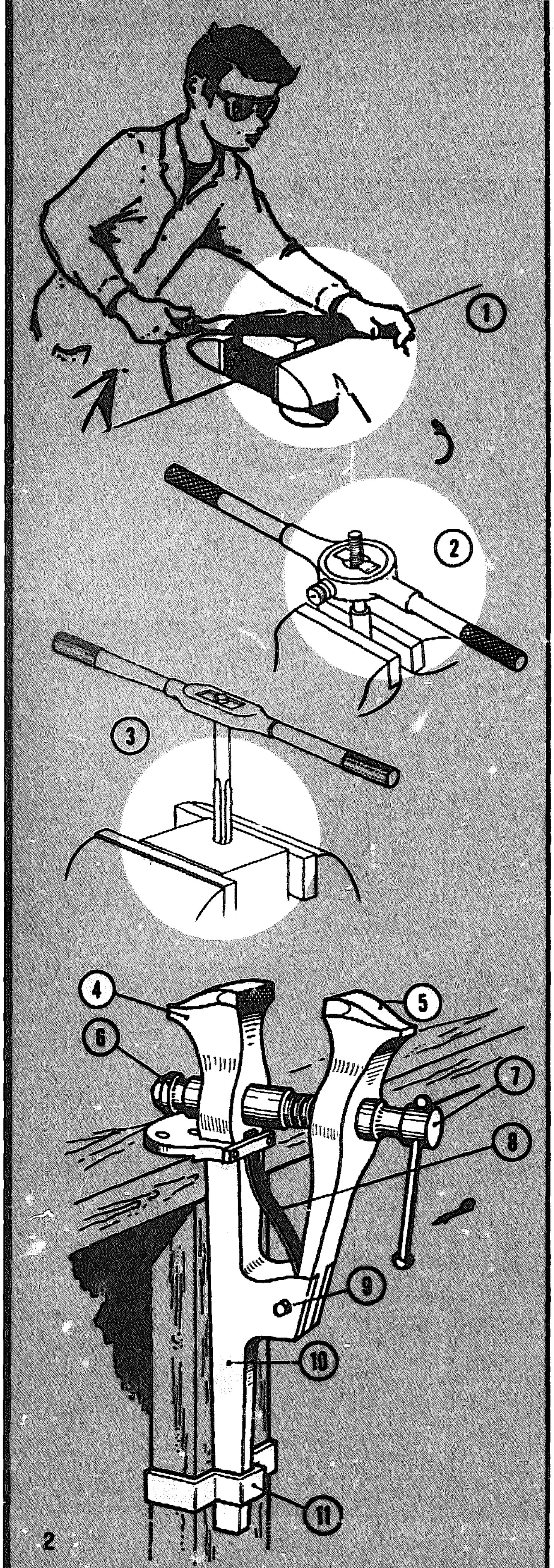
11
Handle

Vice clamps are made from a soft material such as lead, copper or mild steel.

12
Various types of vice clamps



The vice is an instrument which is used in many ways. On this page a number of uses of the vice are shown - filing, thread cutting and thread tapping.



1
Filing

2
Thread cutting

3
Thread tapping

4
Solid jaw
5
Movable jaw
6
Threaded bush
7
Spindle
8
Spring
9
Pivot

10
Leg

11
Clamp

Another type of vice is the leg vice. Here the movable jaw turns around a pivot.
As a result the jaws are not always parallel and the work is not clamped as efficiently as in a parallel vice, so there is a greater risk of damage.

This type of vice is still used for rough work, e.g. in the forge.

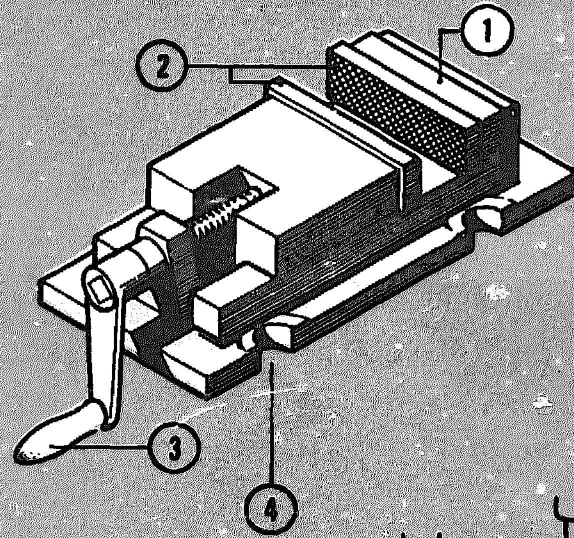
Another clamping device is the machine vice.
Its main use is holding the work during drilling in a drilling machine.

1
Machine vice

2
Jaws

3
Handle

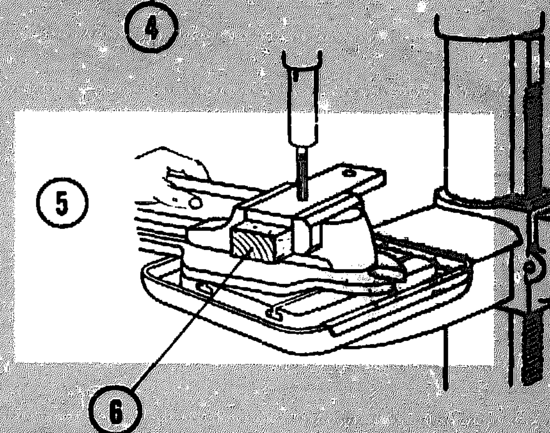
4
Recess for fixing to the driller table

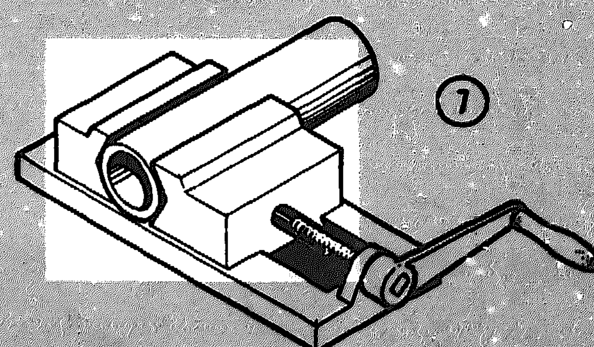


For light drilling the vice can be held in its place by hand but in most cases it is better to bolt it to the driller table by means of two bolts.
For through holes the work should always be clamped in such a way that it is impossible to drill into the vice. This can be done, for instance, by using a wooden packing under the work.

5
Machine vice on drilling machine

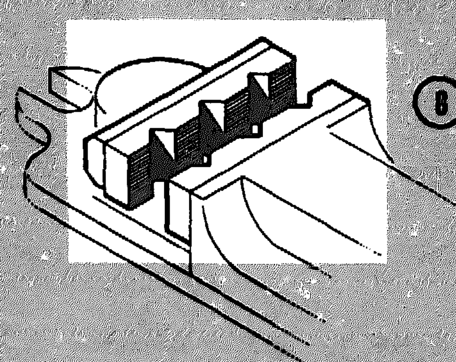
6
Wooden packing block

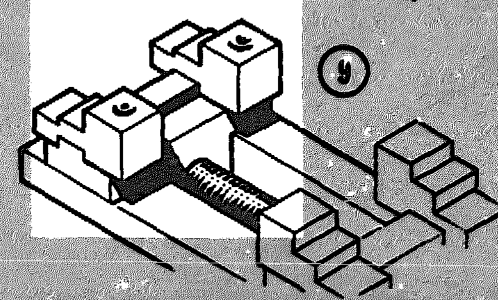


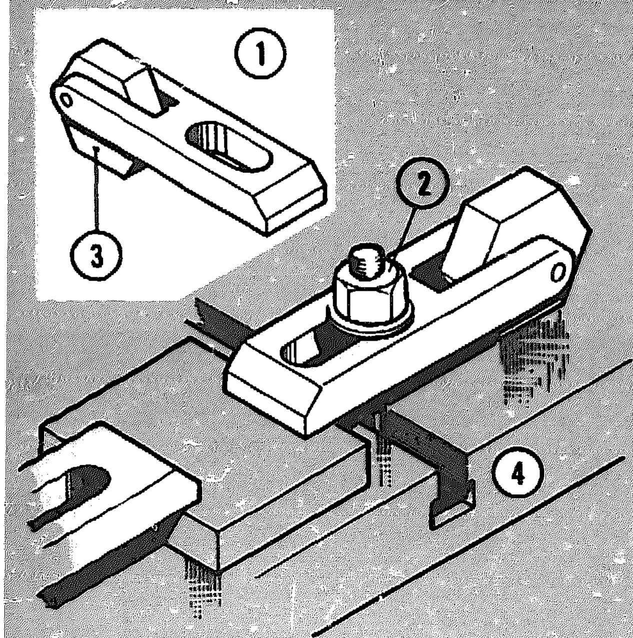


Differences in machine vices are mainly found in the shape of the jaws. Some of them are shown here.

7, 8, 9
Various types of machine vices







1
Clamp (dog)

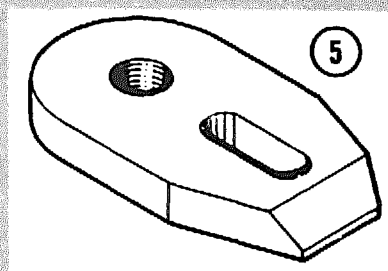
2
Bolt

3
Hexagon

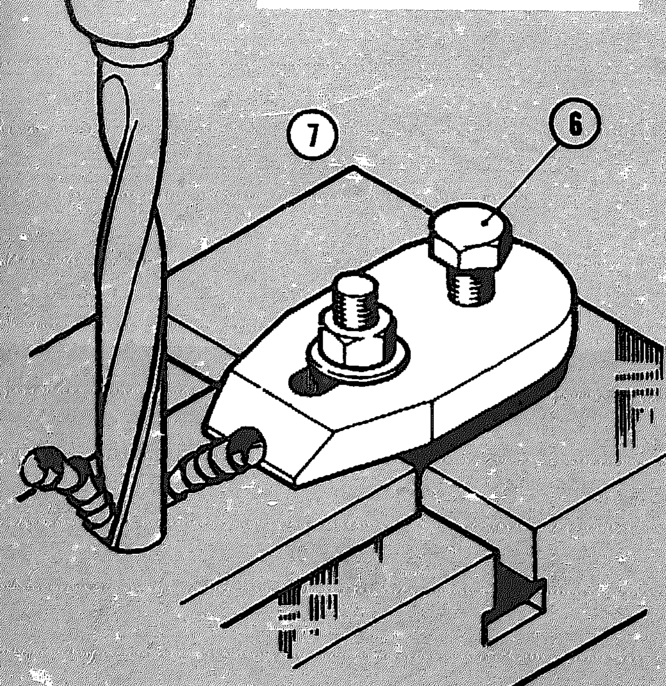
4
Clamping by means of clamps or dogs

The work may also be clamped with various types of clamps, or dogs.
Some of them, and the ways in which they are used, are shown here.

Material of various thicknesses can be clamped by means of the hexagon at the rear.
The adjusting screw is used for the same purpose (see fig. 6).

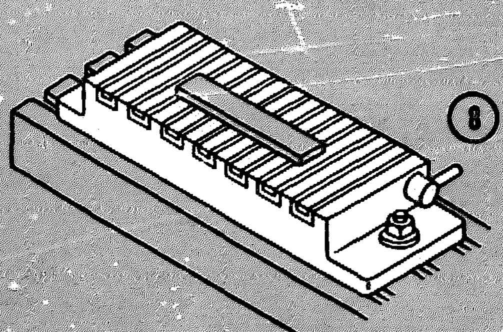


5
Clamp or dog



6
Adjusting screw

7
Work clamped by means of dog



8
Magnetic vice

There are also magnetic vices.

For operations on thin sheet metal special folding bars may be used, or alternatively two pieces of angle section may be taken between which the work is clamped in a vice. If necessary a hand vice or G-cramp is also employed.

1
Folding bars

2
Angle sections

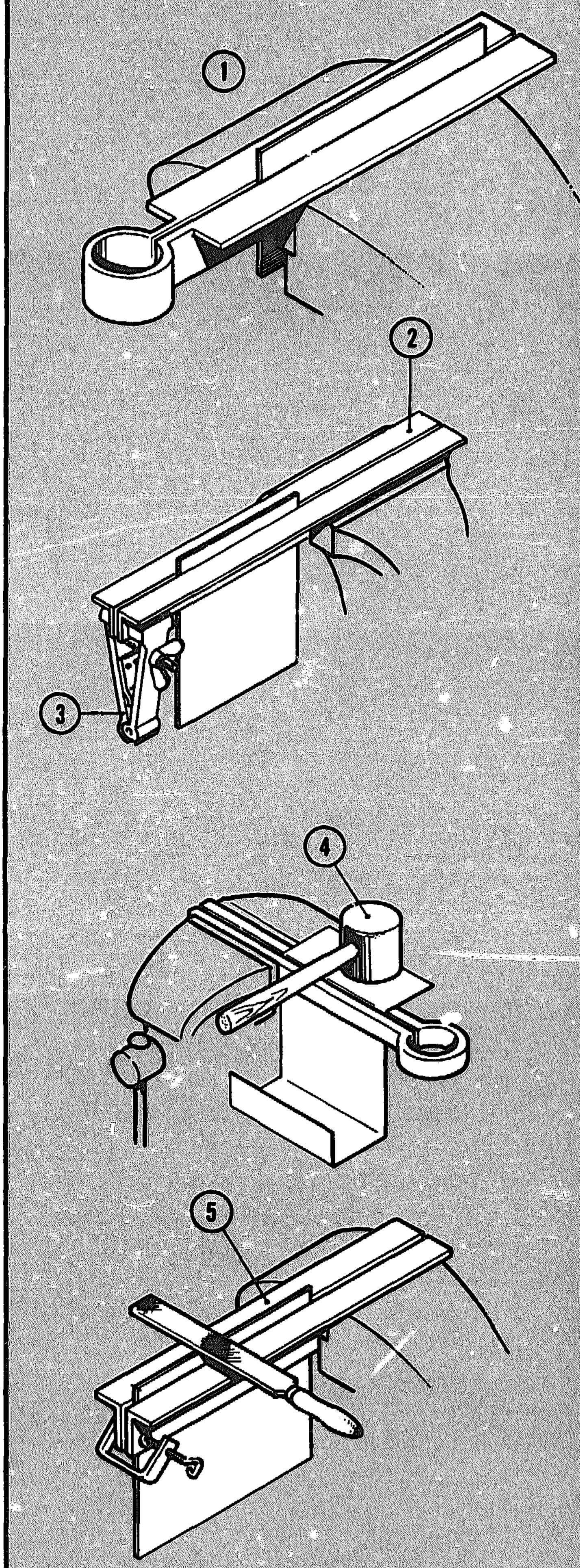
3
Hand vice

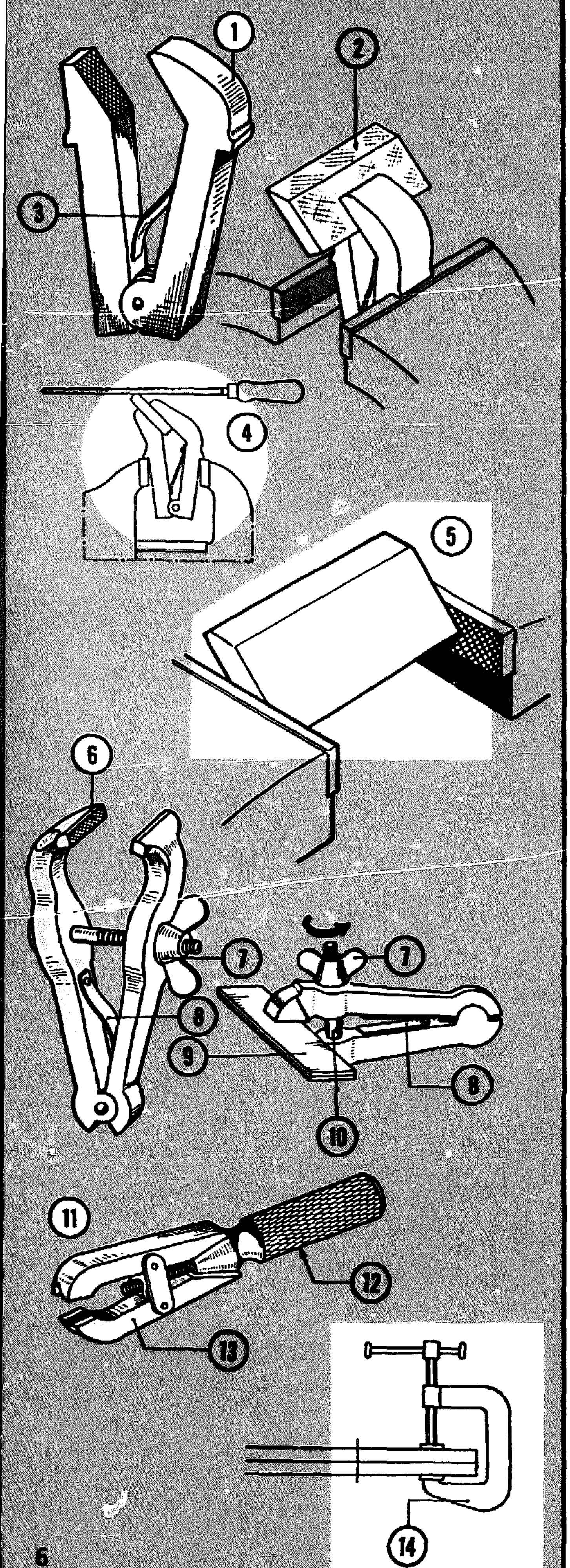
Folding bars are used for bending, chiselling, filing or other operations on sheet metal.

4
Rubber mallet

For filing, clamp the work as low as possible.

5
Angle sections





1
Angle vice
2
Bevelled
edge

For special purposes there exist various types of clamping devices. A number of them, together with their uses are shown here.

3
Spring

4
Filing a
bevelled
edge

For filing a bevelled edge an angle clamp may be used.

5
Clamping at
angle

The work may also be clamped at an angle in the vice. If an angle clamp is used it is held in the vice.

6
Hand vice

A hand vice is used for holding together a number of things, for instance when they have to be drilled.
The hand vice is tightened by means of the wing nut.

7
Wing nut

8
Spring
9
Workpiece
10
Stud

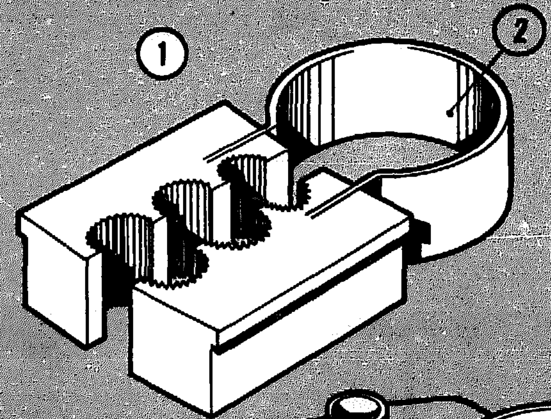
11
Pin vice
12
Knurled
handle
13
Jaws

The pin vice. By turning the knurled handle the jaws are opened or closed.

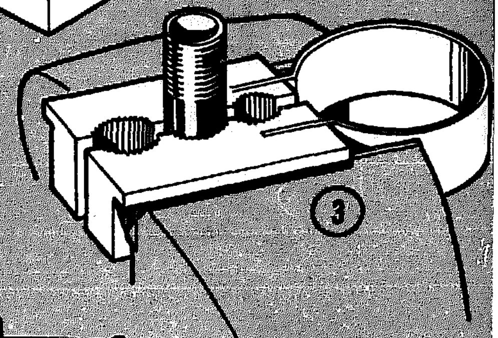
14
G-cramp

Pipes may easily be distorted if they are clamped in the vice.
Therefore they may be held in a pipe clamp.

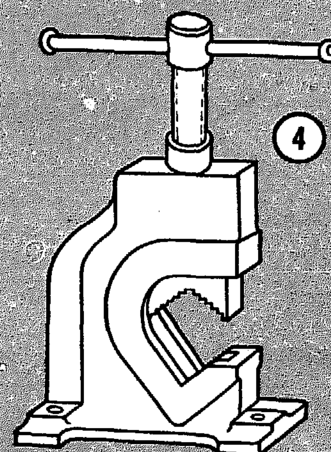
1
Pipe clamp
2
Spring



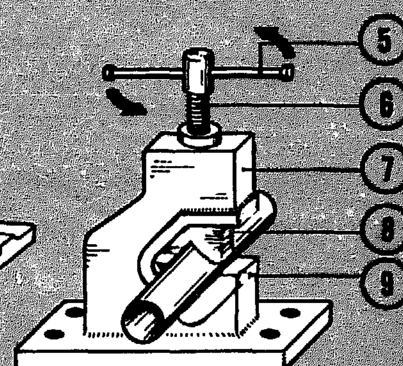
3
Pipe clamp in vice



4
Yoke vice



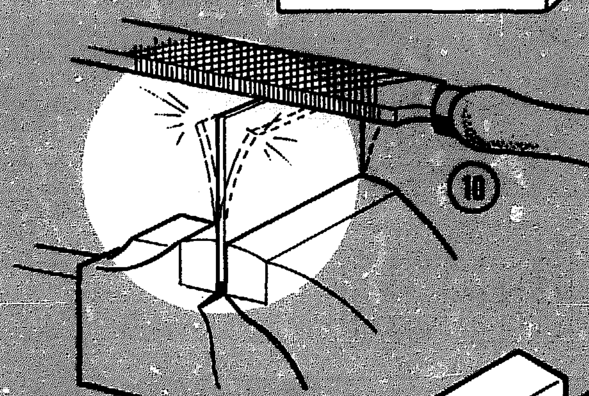
5
Handle
6
Threaded spindle
7
Yoke
8
Movable jaw
9
Solid jaw



A few instructions:

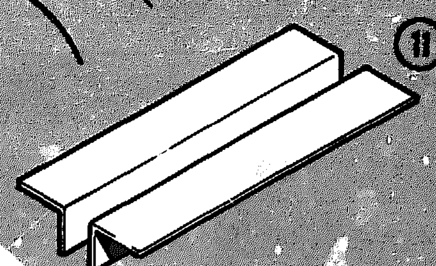
— Clamp the work as low as possible. It makes working less noisy and saw or file will live longer as teeth will not break so easily.

10
Work too high in vice



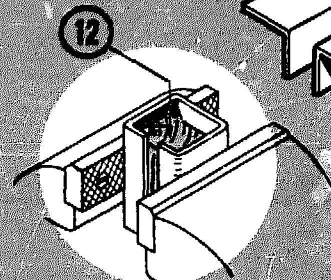
— If necessary use vice clamps to prevent finished parts from being damaged. Before clamping remove any filings from jaws or clamps.

11
Vice clamps

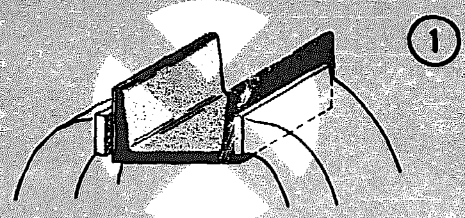


— Avoid distortion of the work by using packings.

12
Wooden packing

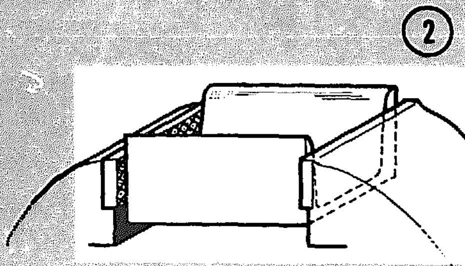


Examples of correct and incorrect clamping.



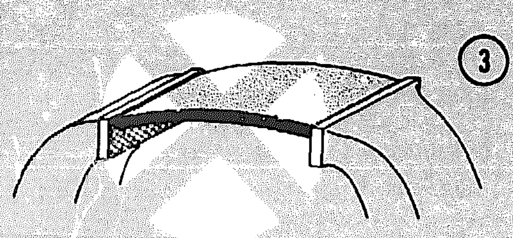
1
Wrong

In fig. 1 the channel section will bend when the vice is tightened.



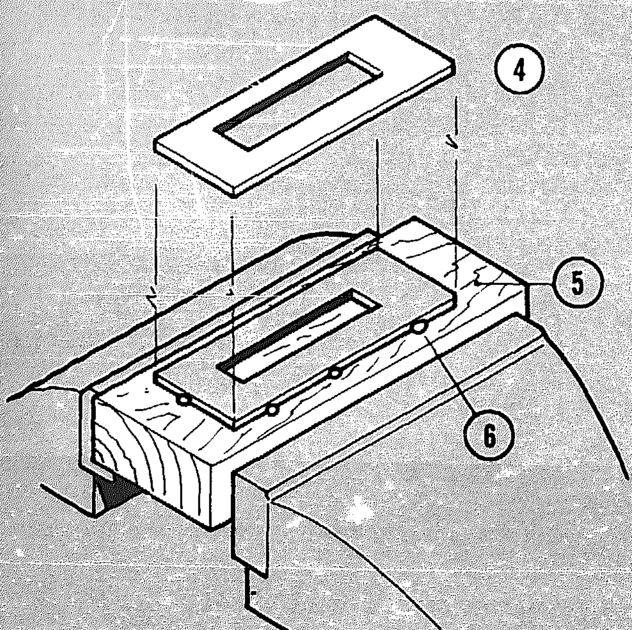
2
Correct

In fig. 2 no distortion will occur.



3
Wrong

If a long, thin workpiece is clamped lengthwise it may collapse.

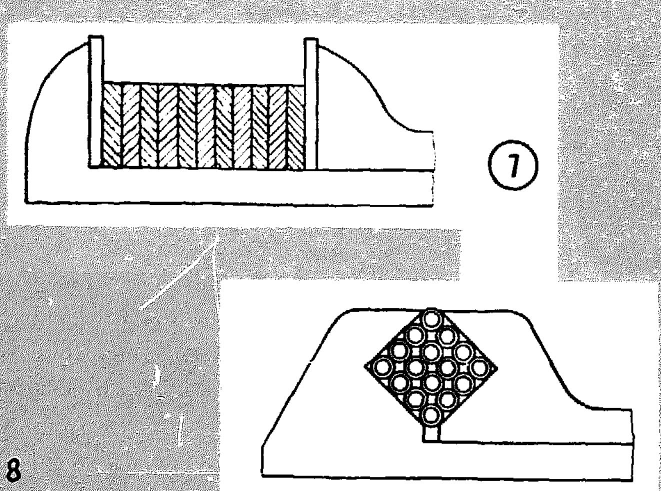


4
Correct

Therefore it should be either clamped crosswise or else supported by a piece of wood to which it is fastened by means of panel pins.

5
Piece of wood

6
Panel pins



7
Clamping together

If a number of pieces of the same length are to be cut off they may be clamped together in a machine vice.

ISBN 90 217 1013 7 CLAMPING

INTEMS PICTORIAL SYSTEM

HAND TOOLS

By hand tools are meant
hammers,
spanners,
pliers, wrenches,
screwdrivers,
drifts and punches.

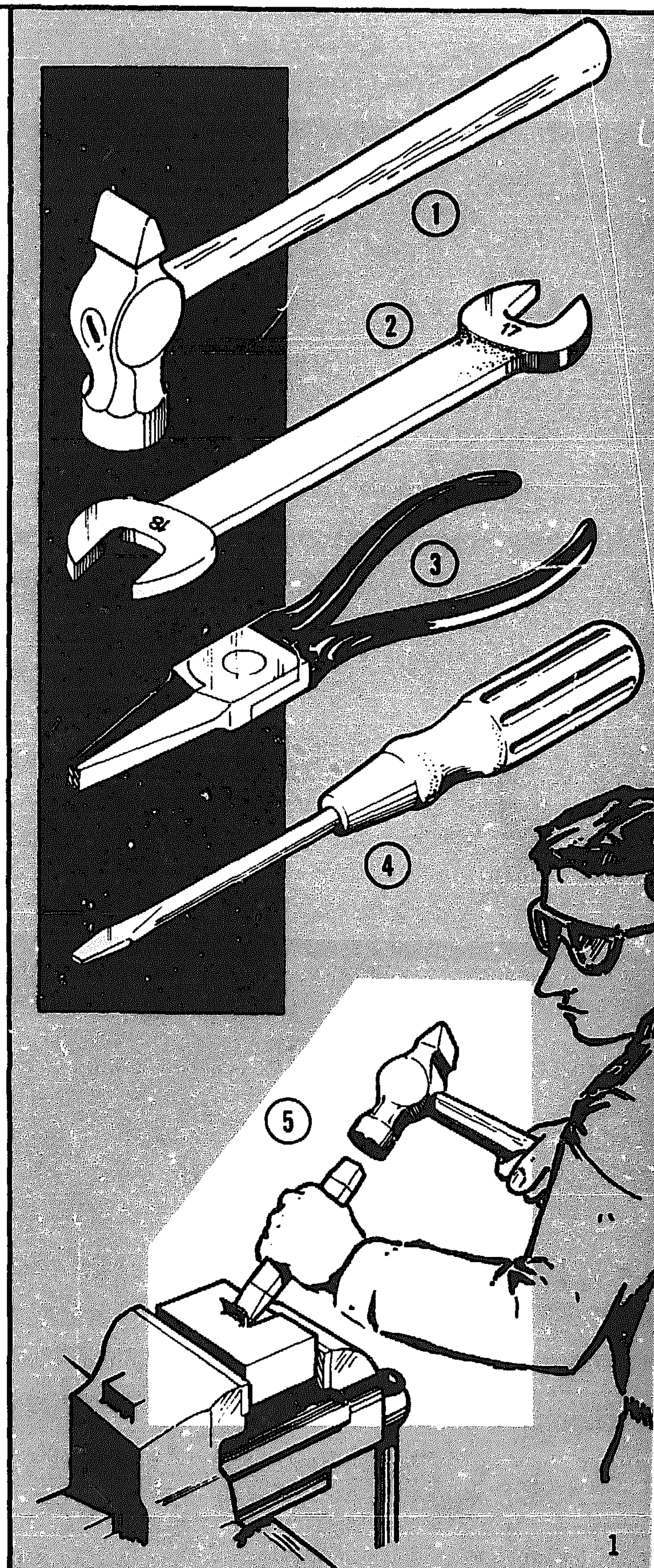
In this lesson some types of each and their uses are discussed.

1 Hammer

2 Spanner

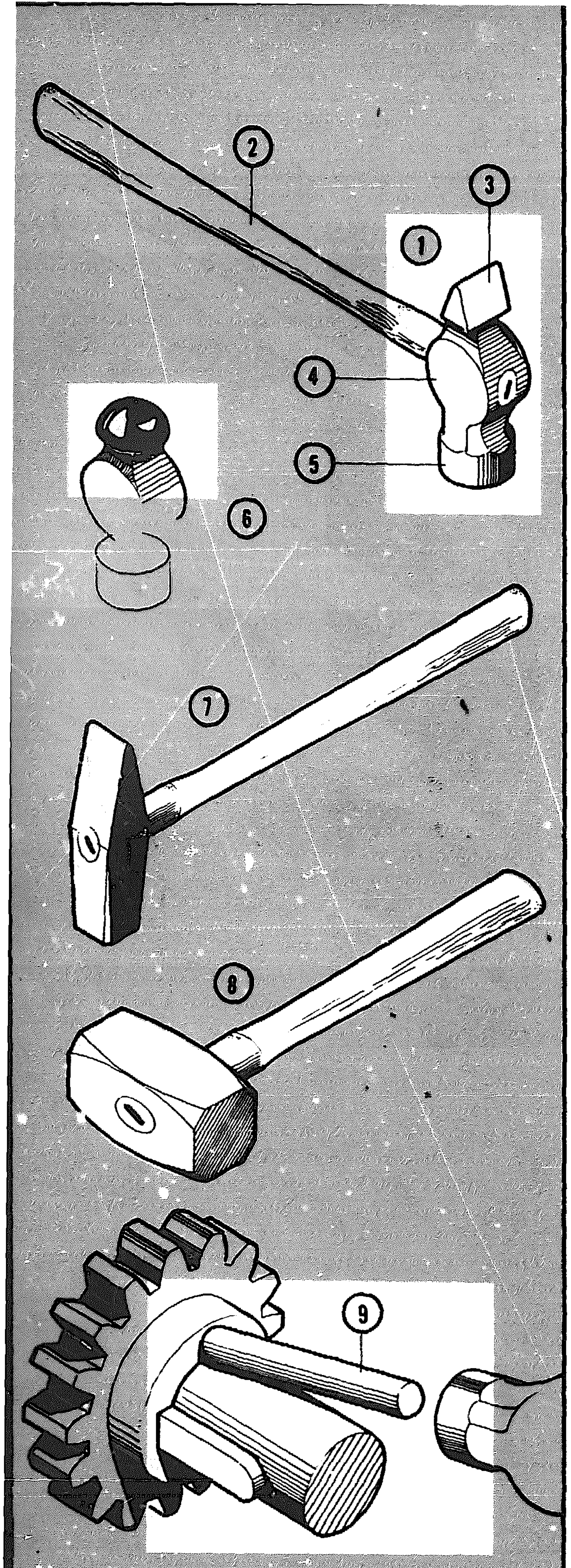
3 Pliers

4 Screwdriver



A hammer can be used for many purposes. The man in fig. 5 is busy chiselling.

5 Use of hammer



1 Head

2 Handle

3 Pein

4 Cheek

5 Face

6 Ball pein

7 Hammer

8 Copper hammer

9 Copper peg

HAMMERS

The two parts of a hammer are the head and the handle.

The parts of the head are called
the face,
the cheek,
the pein.

For general fitting work the cross pein hammer, shown in fig. 1 is used.

There are also ball pein hammers.

For light work a light hammer is used, for heavy work a heavy hammer.

In fig. 7 a different type of hammer is shown. Where is the face, where the pein here? (Mark face X, mark pein XX). This hammer is often used for riveting.

The copper hammer shown in fig. 8 is used for assembling and disassembling machine parts which must not be damaged.

Instead of a copper hammer, a piece of wood or a copper peg may be used. The copper peg is used as a tool. In this case the hammer need not be a copper one.

MALLETS

Other hammers used for working on machinery are:

- the wooden mallet
- the rawhide mallet
- the plastic mallet
- the copper mallet

1 Wooden mallet

2 Rawhide mallet

The heads of plastic mallets are often interchangeable.

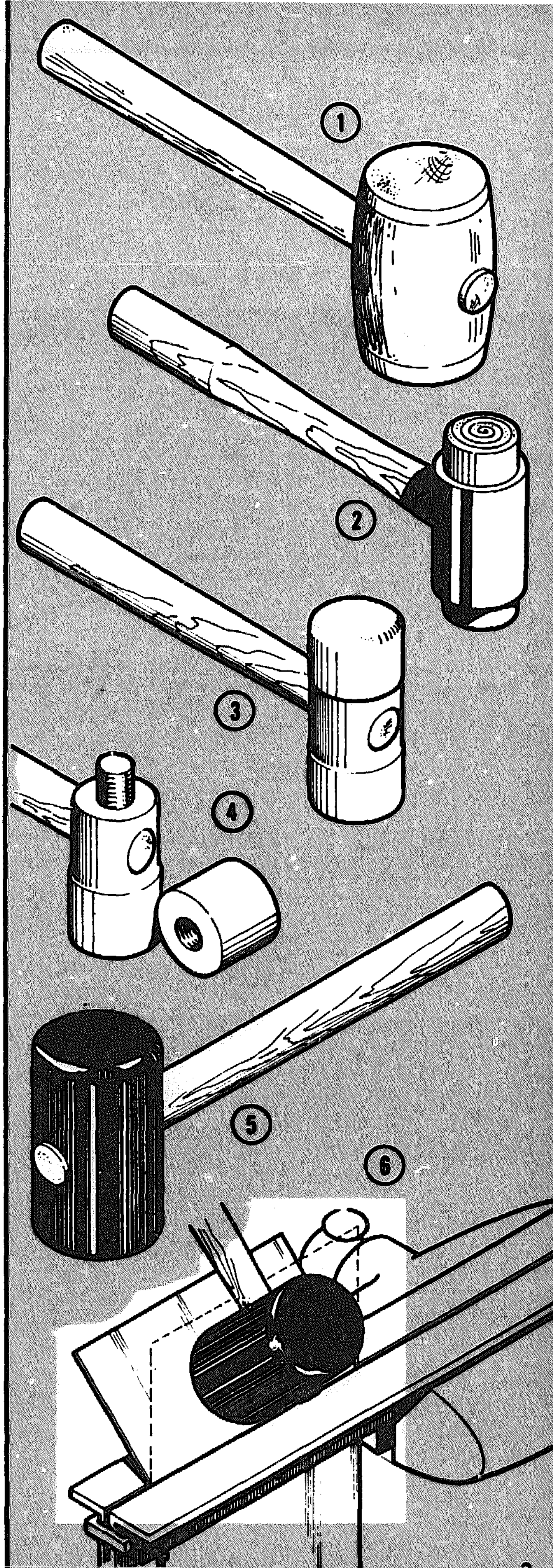
3 Plastic mallet

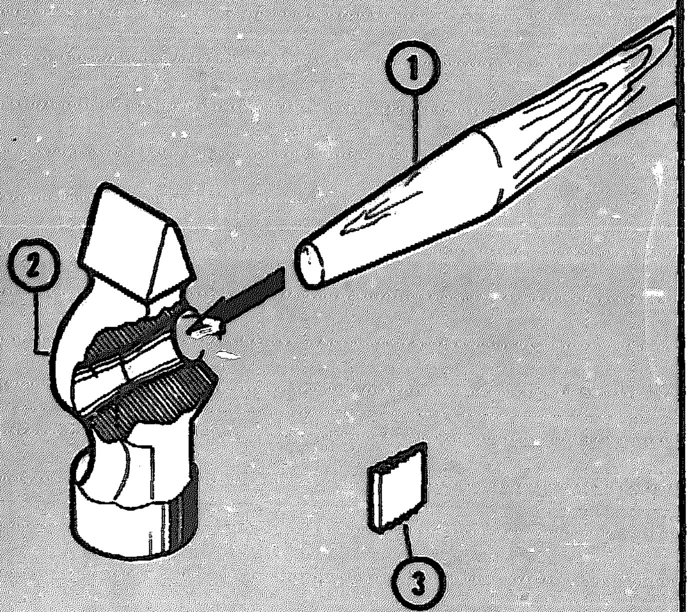
4 Interchangeable head

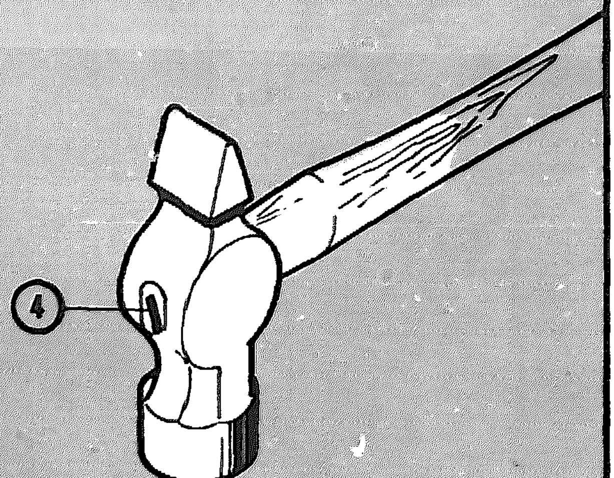
For sheet metal work a rubber mallet is used.

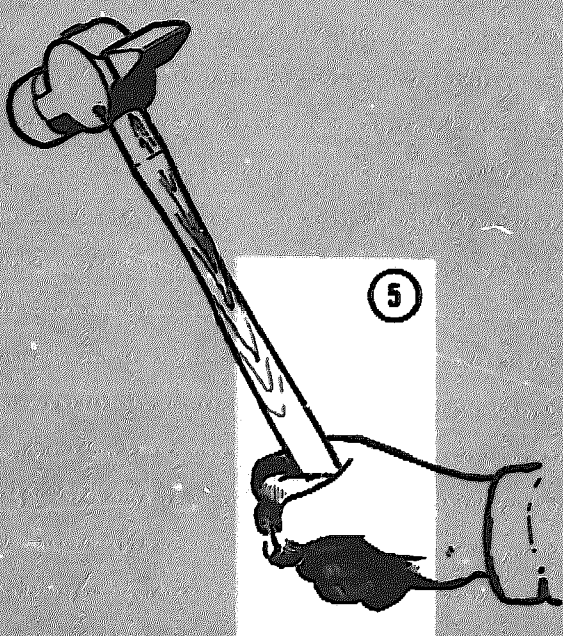
5 Rubber mallet

6 Sheet metal work









1
Handle

The handle should fit tightly in the eye of the hammer head. The eye is narrower in the middle.

2
Head

By driving a wedge into the upper end of the handle, the shaft is made to expand and thus secures the head tightly.

3
Wedge

4
Position of wedge

Note the position of the wedge.

5
Holding a hammer

The hammer is always held by the end of the handle, which acts more or less as a spring and enables heavier blows to be given.

If the thumb is placed on the top of the shaft, the striking movement is more accurate. This is especially so for forgework where directional blows are important.

SPANNERS

Spanners are used for tightening and loosening bolts and nuts.

A DOUBLE ENDED SPANNER is shown here.

For each size of nut or screw head a fitting spanner should be used.

The width of the nut gap is indicated on the jaw either in millimetres or in inches.

The bar is at an angle of 15^{o} to the jaw so that a turning angle of 30^{o} is sufficient if space is limited. The spanner can then be used in two ways.

1
Bolt and nut

2
Tightening a nut

3
Jaw

4
Centre bar

5
Nut gap

6
Nut gap size in mm.

7
Nut gap size in inches

8
Position for tighteni in two ways

SPANNERS

Spanners are used for tightening and loosening bolts and nuts.

A DOUBLE ENDED SPANNER is shown here.

For each size of nut or screw head a fitting spanner should be used.

The width of the nut gap is indicated on the jaw either in millimetres or in inches.

The bar is at an angle of 15° to the jaw so that a turning angle of 30° is sufficient if space is limited. The spanner can then be used in two ways.

1
Bolt and nut

2
Tightening a nut

3
Jaw

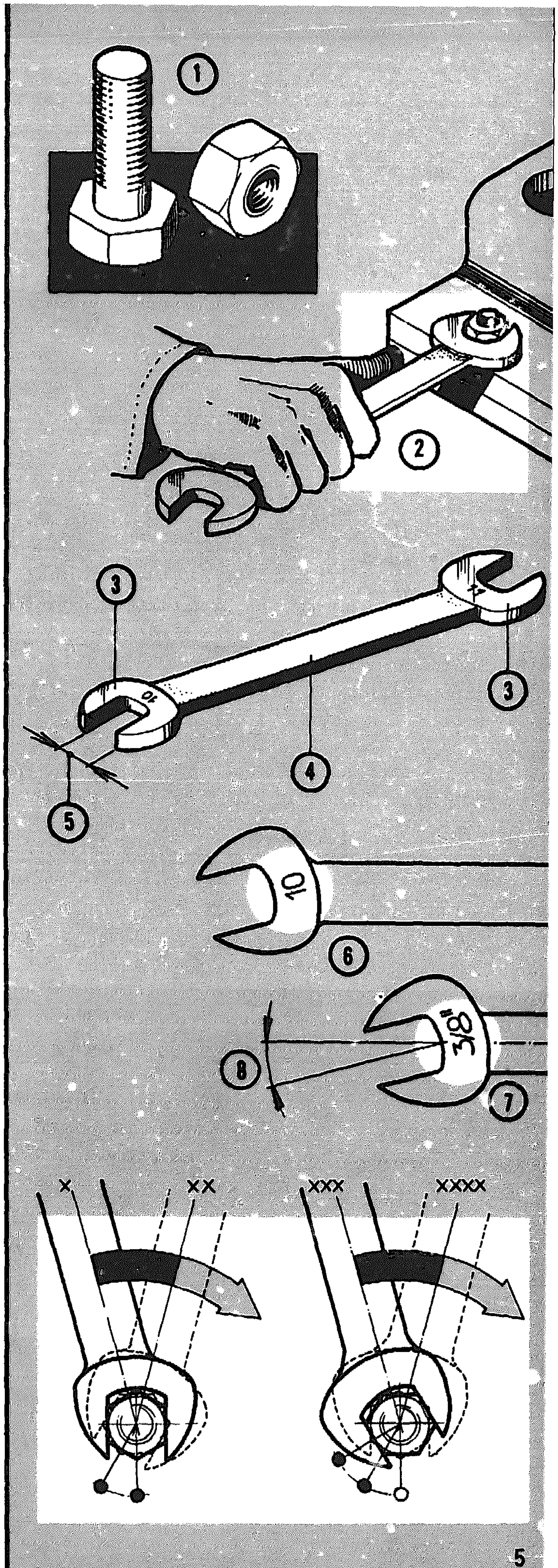
4
Centre bar

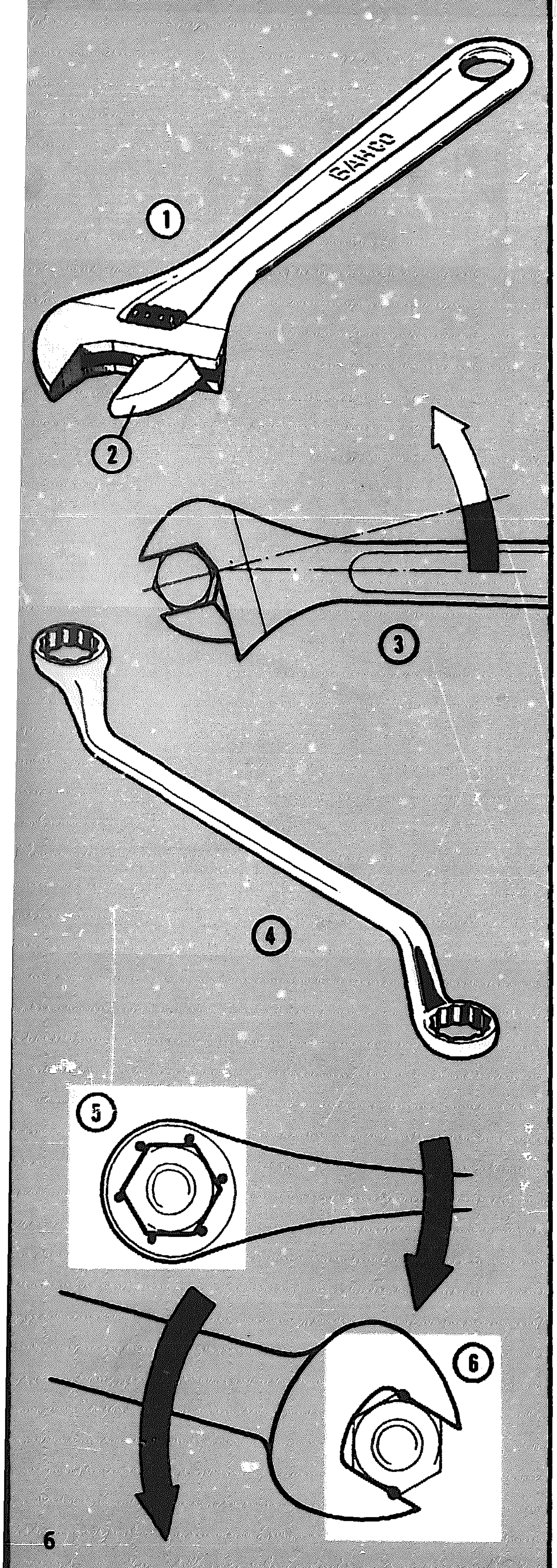
5
Nut gap

6
Nut gap size in mm.

7
Nut gap size in inches

8
Position for tightening in two ways





1 Adjustable spanner (adjustable wrench)	In an ADJUSTABLE SPANNER the jaw width can be adjusted so that fewer spanners are needed.
2 Adjustable jaws	
3 Position for loosening	The bar of an adjustable spanner is also at an angle of 15^{o} to the jaws.
4 Ring spanner (box spanner)	Usually RING SPANNERS are double ended. The holes are hexagonal or dodecagonal.
5 Ring spanner grips at six places	Ring or box spanners grip the nut at six places, so the chance of slipping and damage is smaller. Therefore a ring spanner is safer.
6 Open end spanner grips at two places	

SOCKET WRENCHES consist of a handle and a square key part on which different sockets can be fitted.

1
Handle

2
Square key part

3
Sockets

On one side of the socket is a hexagonal or dodecagonal opening fitting the screw head or nut. On the other side is a square opening fitting the square key part of the handle.

4
Bolt

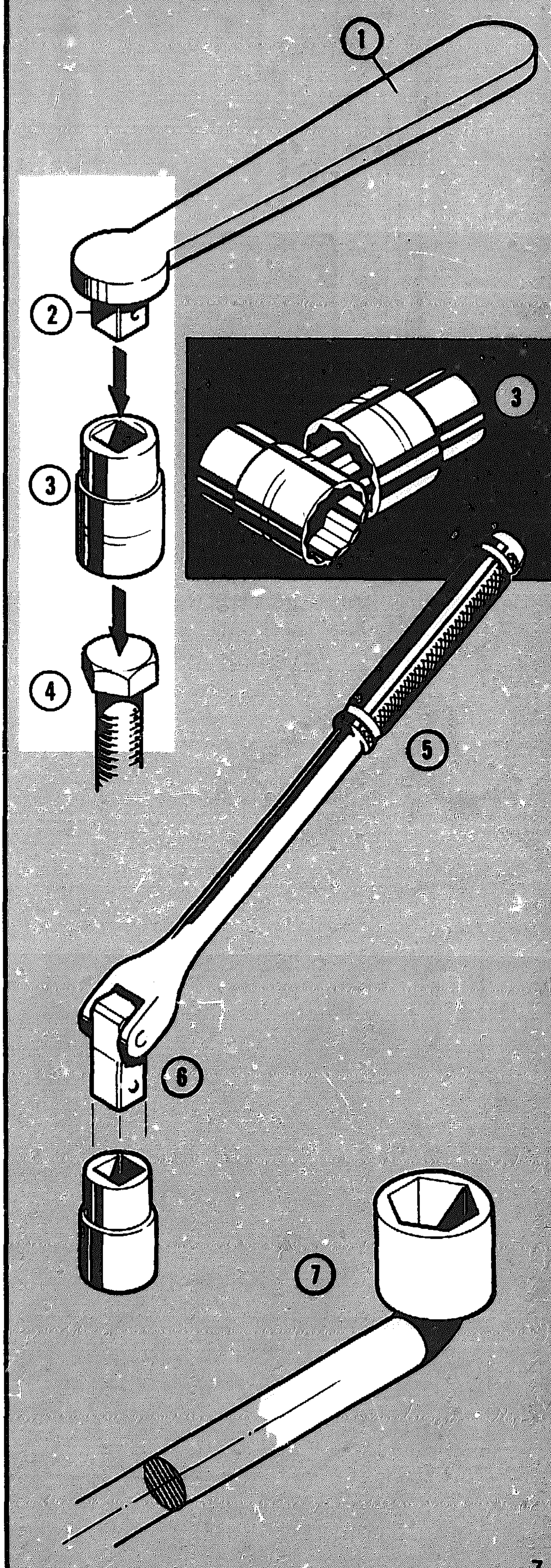
Handles come in different types.

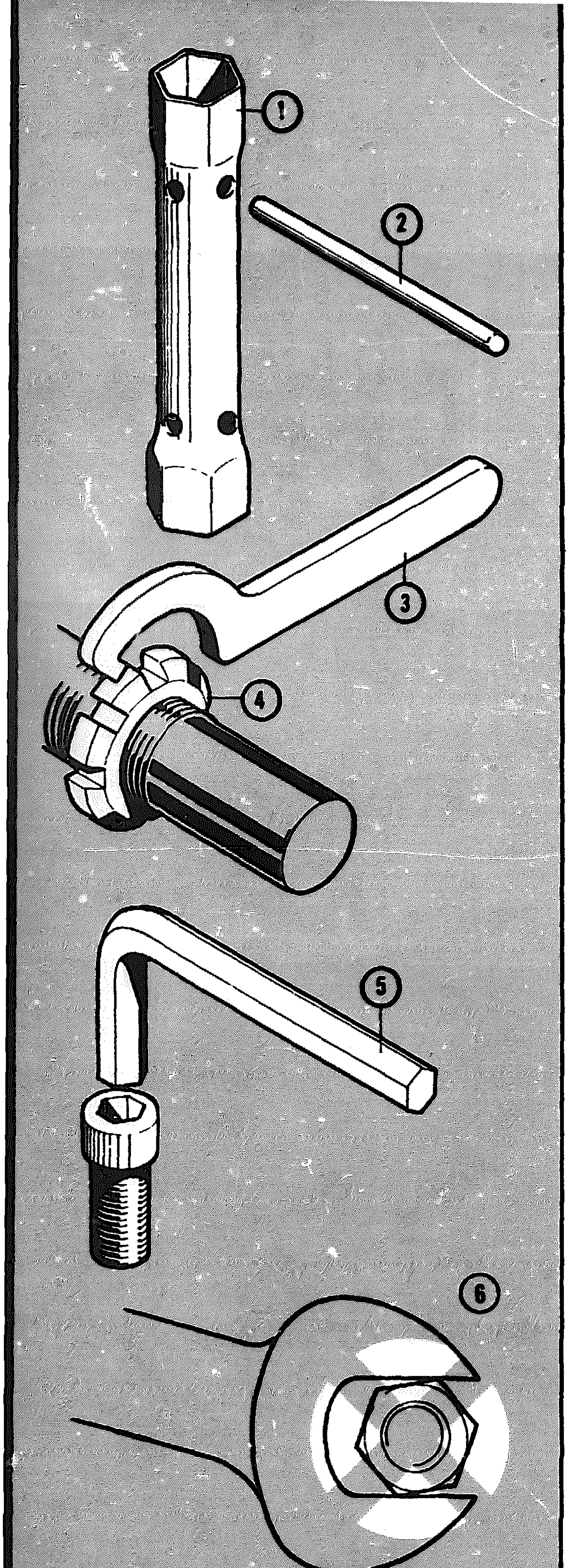
5
Handle for use with hinged key

6
Hinged square key

There also are fixed socket wrenches.

7
Fixed socket wrench





1 Tubular box spanner

A TUBULAR BOX SPANNER has a hexagonal opening at both ends.

2 Tommy bar

To turn the spanner a detachable tommy bar is slid into two holes. These spanners are used in difficult places.

3 Hook spanner

HOOK SPANNERS are used for tightening or loosening ring nuts.

4 Ring nut

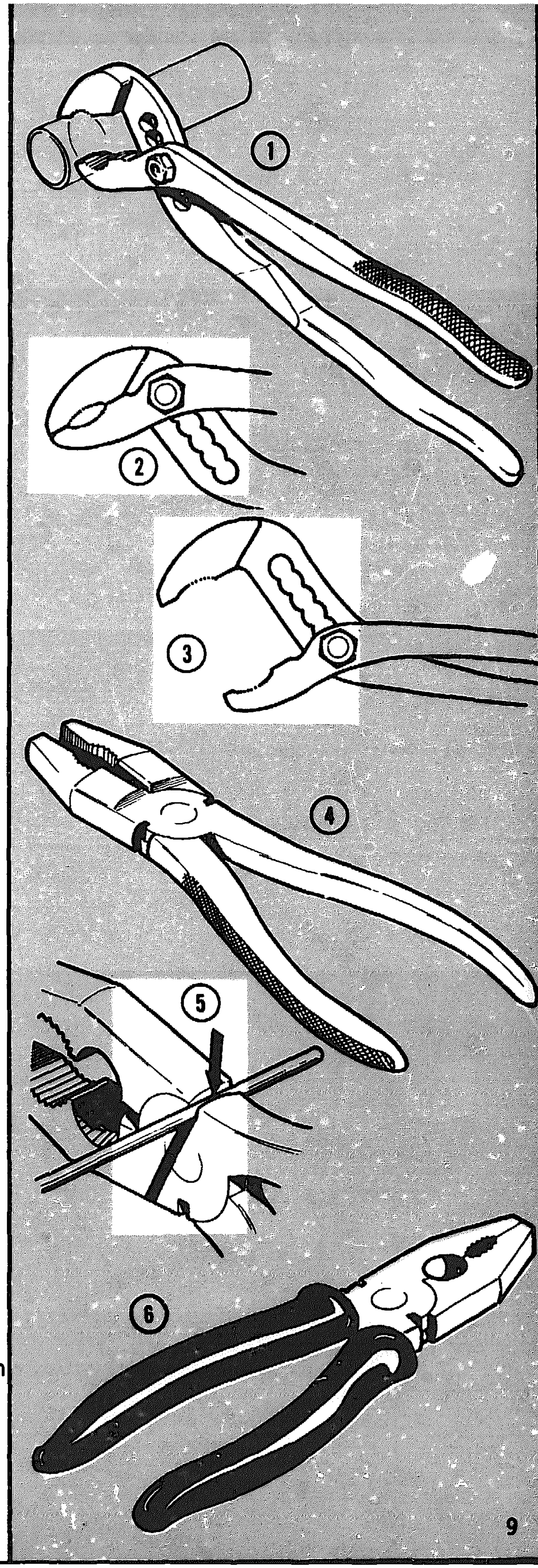
5 Hexagon wrench key

Socket head screws have a hexagonal opening in the head. Such a screw is turned by means of a HEXAGONAL WRENCH KEY.

6 Use the right spanner

Never use worn out spanners, or spanners of which the size of the nut gap is too wide. They may slip off the nut or bolt and cause accidents, or damage heads or nuts.

WRENCHES, PLIERS, ETC.



Pliers and grips are used for:

- holding,
- tightening and loosening,
- bending,
- cutting.

1
Pipe wrench

The pipe wrench has an adjustable pivot point enabling pipes of different sizes to be gripped.

2
Smallest position

3
Largest position

Combination pliers can be used for various purposes:

- bending,
- cutting,
- holding pipes.

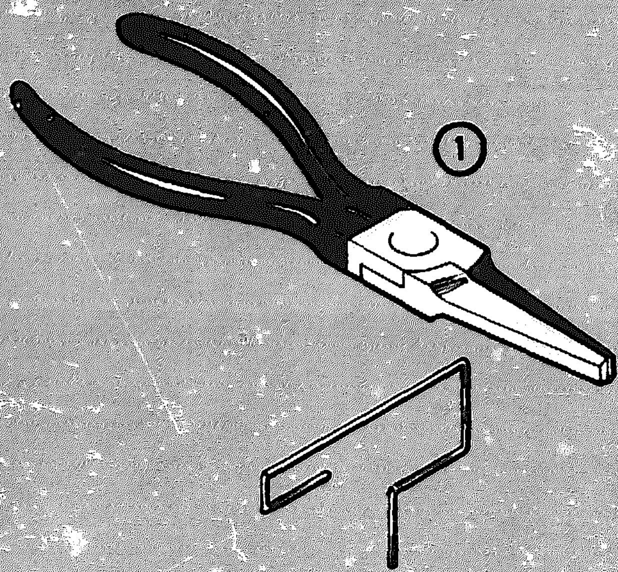
4
Combination pliers

5
Cutting a wire

Sometimes the handles are covered with rubber or plastic. This type of pliers is used by electricians to protect them against dangerous shocks when working on live parts.

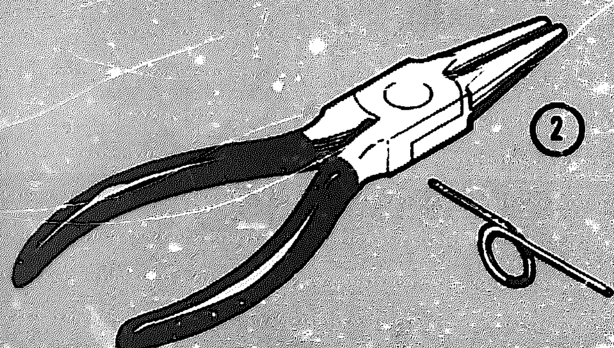
6
Insulated combination pliers

1 Flat-nosed pliers	Flat-nosed pliers are used for light bending work.
2 Round-nosed pliers	Round-nosed pliers are used for bending curved and round shapes like eyes in metal wire.
3 Pincers	Pincers are used for removing nails and for cutting wire.
4 Using a pair of pincers for removing a nail	



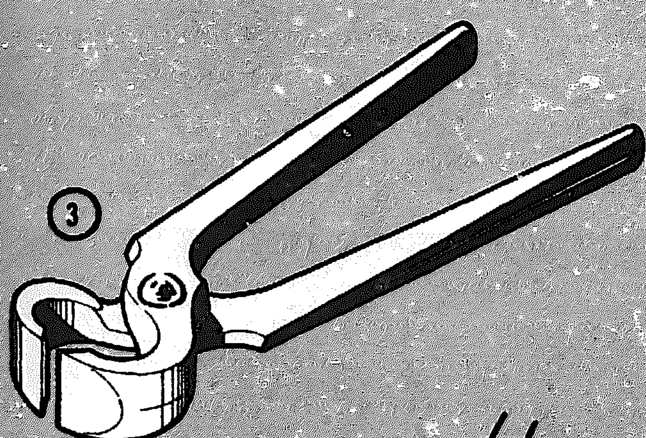
1
Flat-nosed pliers

Flat-nosed pliers are used for light bending work.



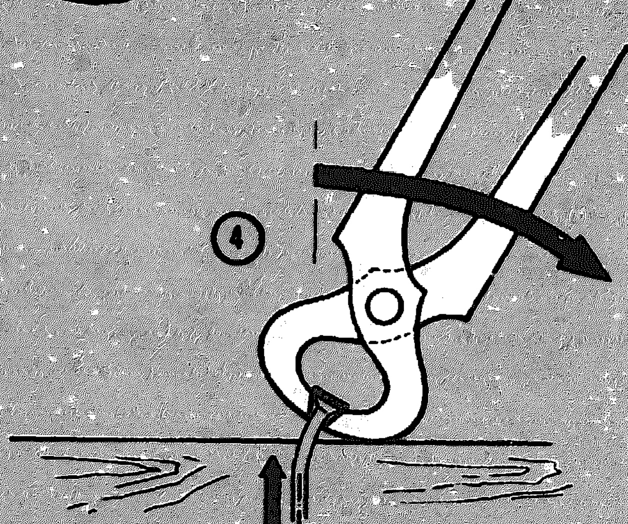
2
Round-nosed pliers

Round-nosed pliers are used for bending curved and round shapes like eyes in metal wire.



3
Pincers

Pincers are used for removing nails and for cutting wire.



4
Using a pair of pincers for removing a nail

Nippers are used for cutting wires. The lever type nippers can be used for cutting hard spring steel wire because greater force can be exerted.

1
Lever type top cutting nippers

2
Top cutting nippers

3
Side cutting nippers

SCREWDRIVERS

A screwdriver is used for fastening and loosening slotted screws. The slot of a screw is in the head.

4
Using a screwdriver

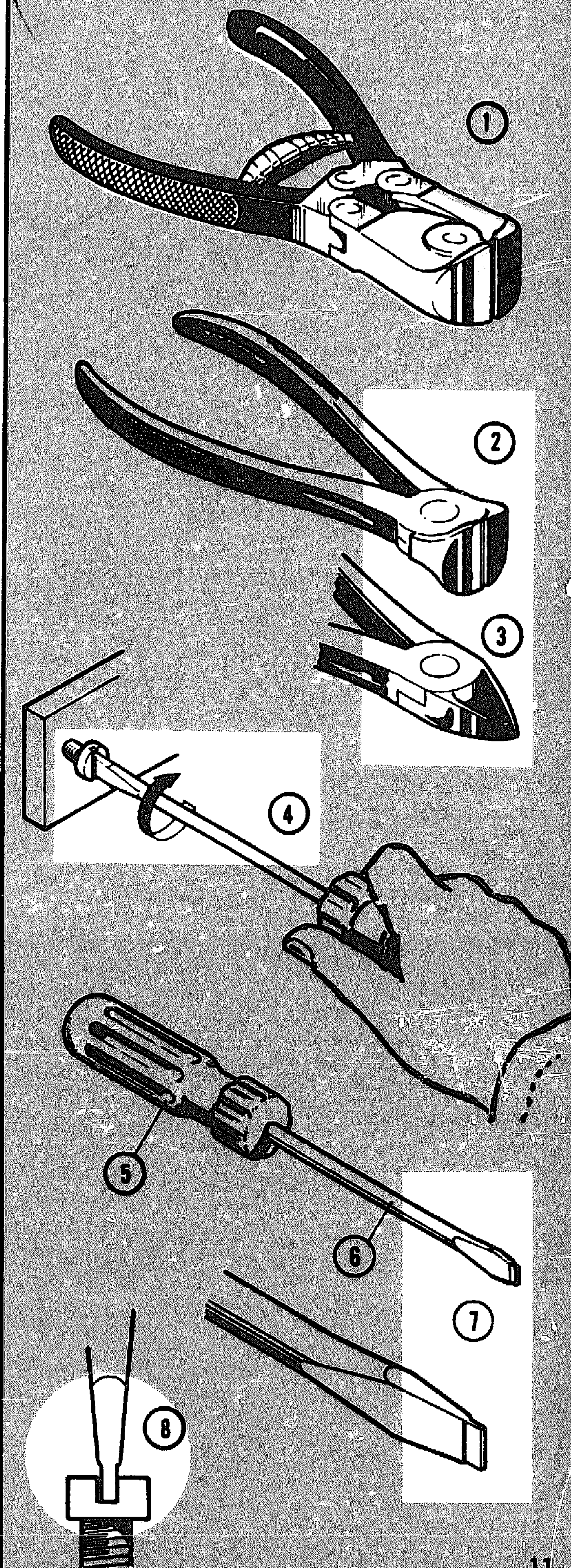
5
Handle

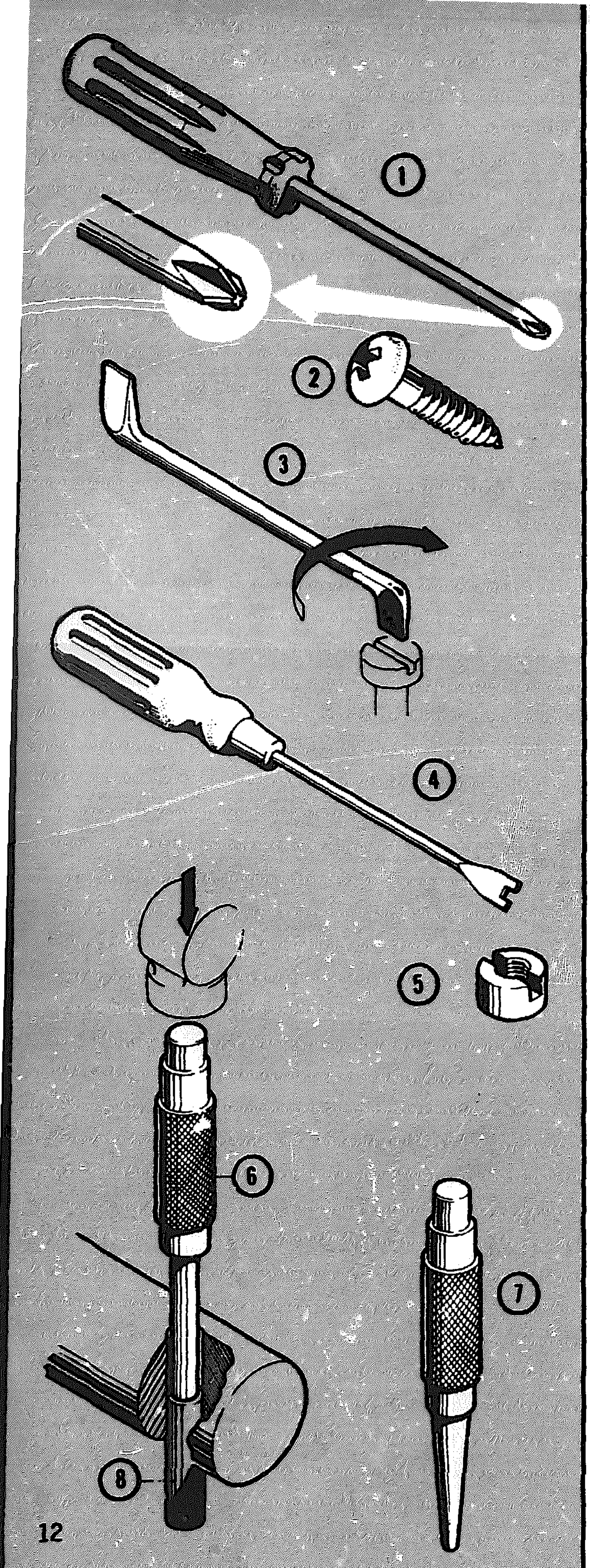
6
Shank

7
Blade

Always use a screwdriver fitting the slot in the screw head.

8
Shape of blade





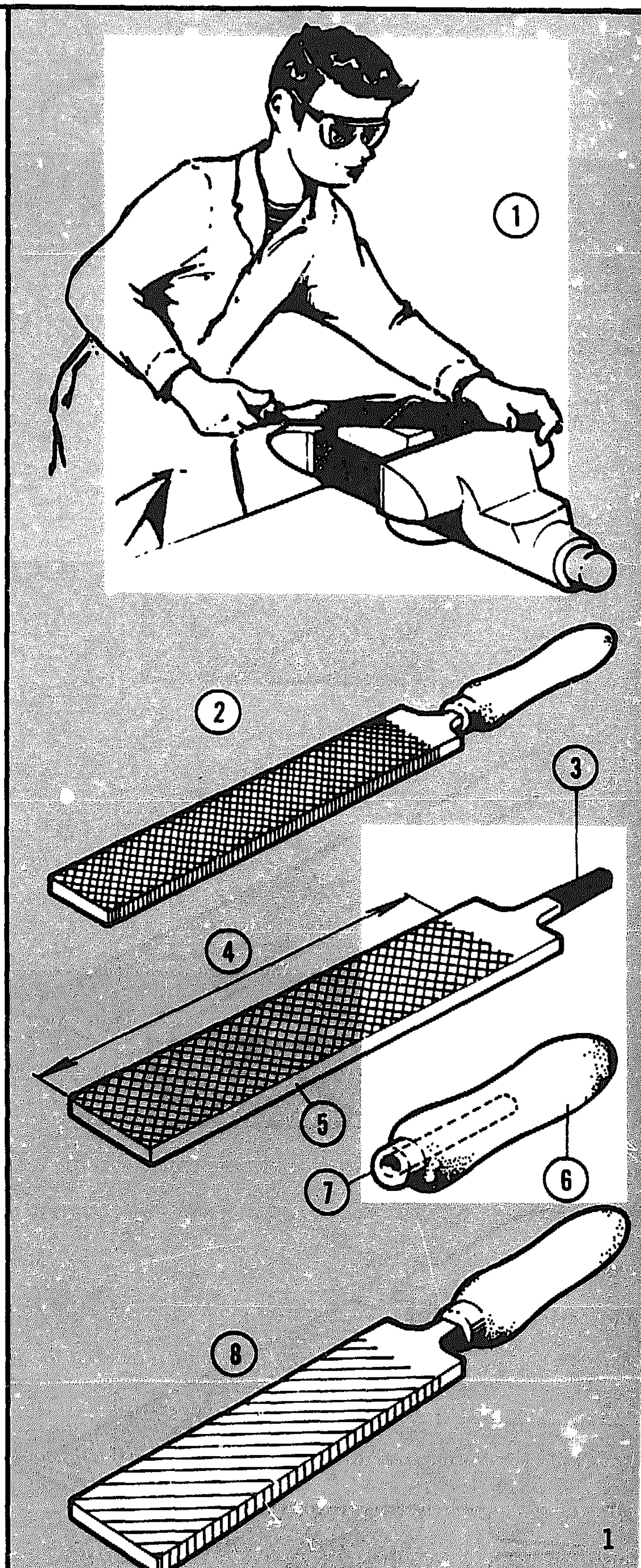
1 Phillips screwdriver	Screw heads with a cross-shaped socket are called Phillips heads. Special Phillips screwdrivers are used for them.
2 Screw with Phillips head	
3 Offset screwdriver	In difficult places that cannot be reached by a common screwdriver an offset screwdriver may be used.
4 Forked screwdriver	Forked screwdrivers are used for special purposes, for instance for slot nuts.
5 Slot nut	
	DRIFTS AND PUNCHES
6 Drift	The drift is used for removing pins.
7 Punch	The punch is used for making holes in thin sheet metal.
8 Pin to be removed	

ISBN 90 217 1014 5 HAND TOOLS

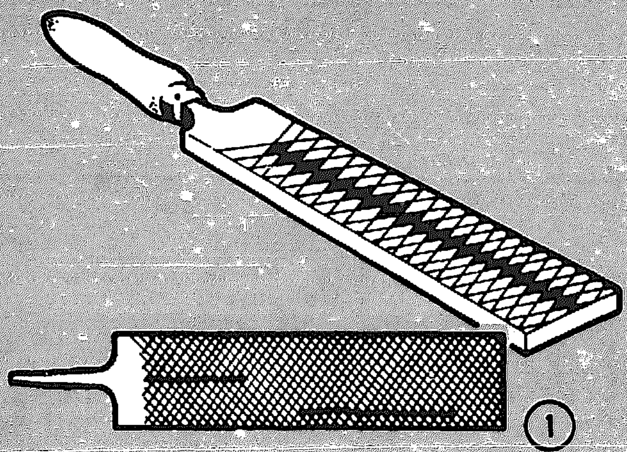
INTEMS PICTORIAL SYSTEM

FILING

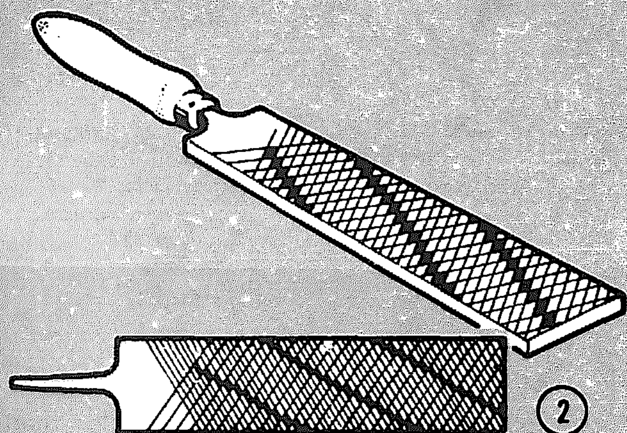
Filing is an operation through which the surface of a workpiece can be moulded by removal of very small particles (filings).	1 Filing
A file is a metal bar with a great number of teeth cut into it.	2 Double cut file
The sharp point on the end of a file is called the tang.	3 Tang
The length of the file containing the teeth is called the cutting length.	4 Cutting length
If one of the edges is not cut this is called the safe edge.	5 Safe edge
The handle is fitted on the tang.	6 Handle
On the handle is a steel ring, the ferrule, to prevent the handle from cracking.	7 Ferrule
	8 Single cut file



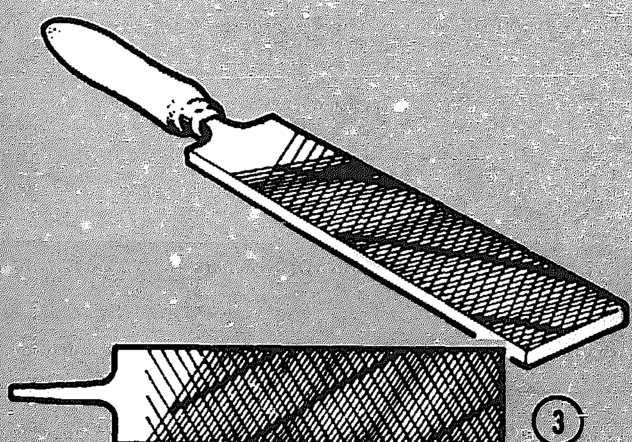
Depending on the way in which the cut is made, the patterns of the teeth have different names.



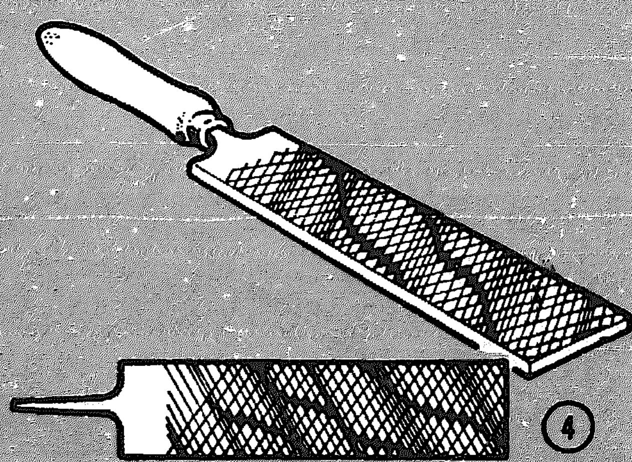
1 Straight track.



2 Right hand track.



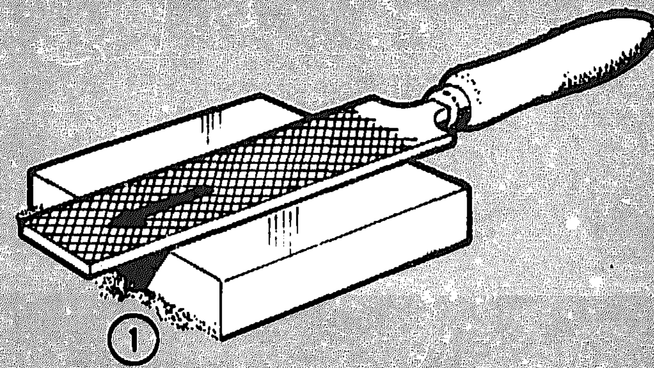
3 Left hand track.



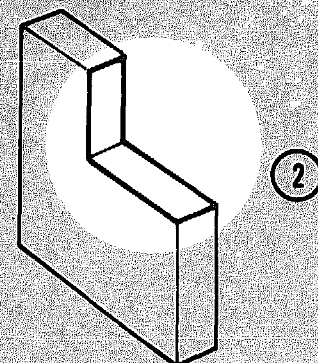
4 Wavy track.

Filing is frequently carried out to make surfaces level, and also for producing the surfaces illustrated in the figures 2 - 8.

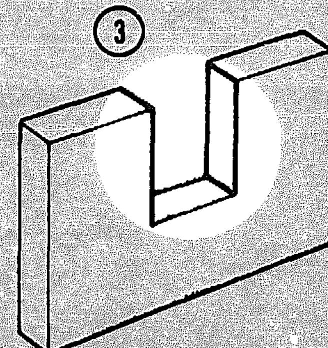
By moving the file across the surface of the work we remove tiny particles called filings. — 1 Filings



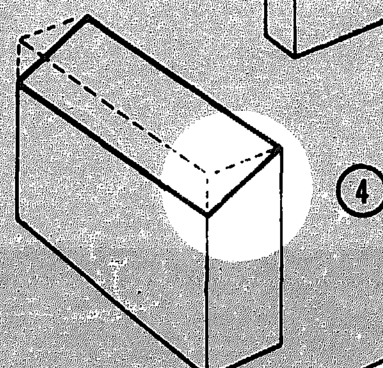
Surfaces at right angles. — 2



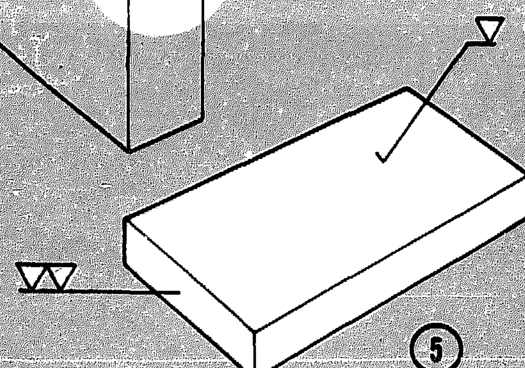
Parallel surfaces. — 3



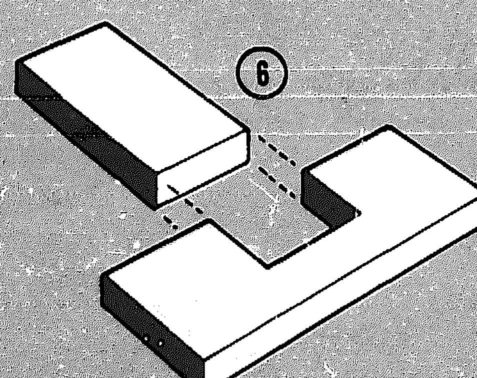
Surfaces at an angle. — 4



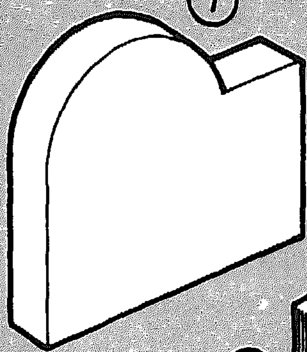
Surfaces with a specified degree of smoothness. — 5



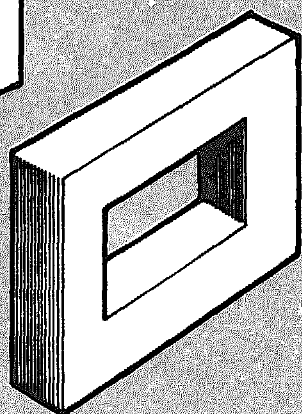
Fits between two parts. — 6



See next page (4). — 7 and 8

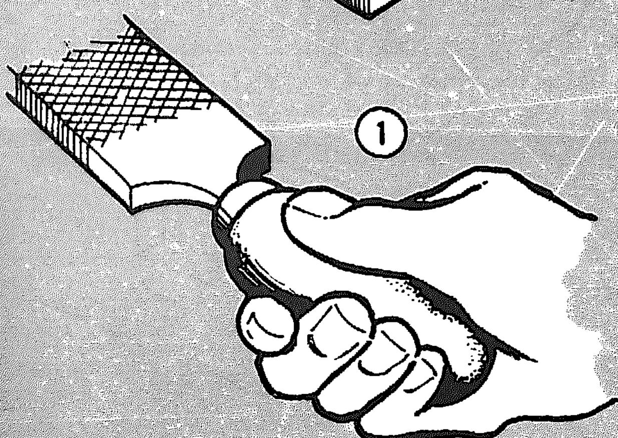


7 Rounds.



8 Inner cut-outs.

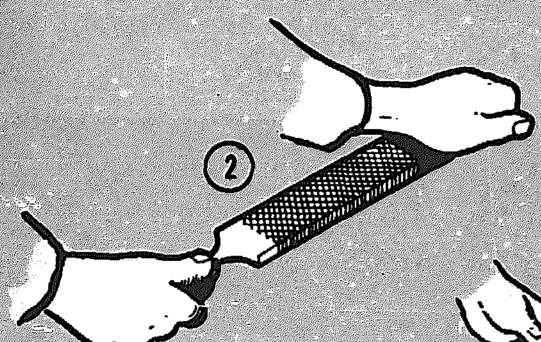
HANDLING THE FILE



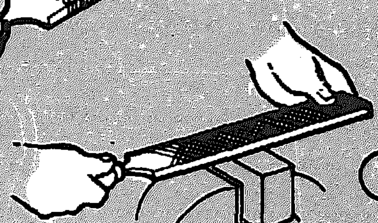
1 The thumb should rest lightly on the handle. By pushing with the palm the file is moved forward across the work, the left hand pressing on the end of the file.

The file teeth will stay sharper if you do not press during the backward stroke.

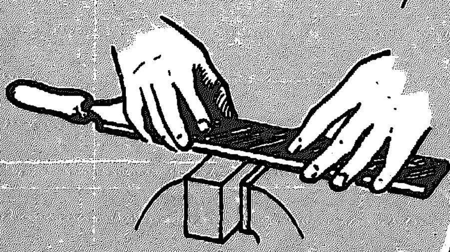
Figures 2 to 5 show the position of the hands for some special operations.



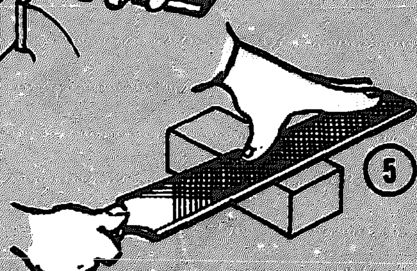
2 For heavy work.



3 For light work.



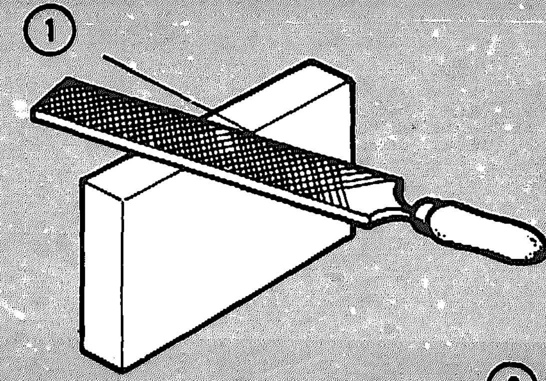
4 For finishing off.



5 For removing local uneven-esses.

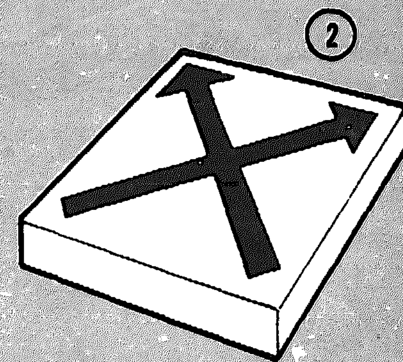
For narrow surfaces the file is held at an angle of 15 degrees.

1
Angle 15^{0}



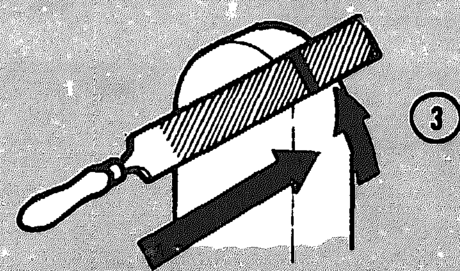
For large surfaces the file should be used crosswise, i.e. the strokes should alternate in direction.

2
Crosswise filing

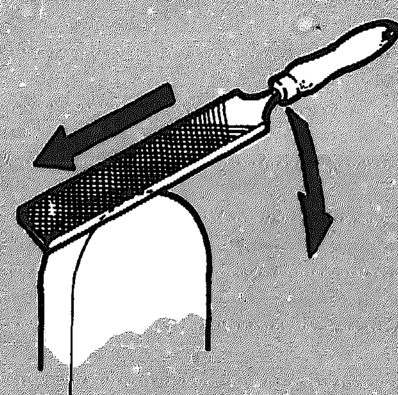


Curved surfaces are first given their rough outline. Then they are filed accurately to shape.

3
Curved outer surfaces



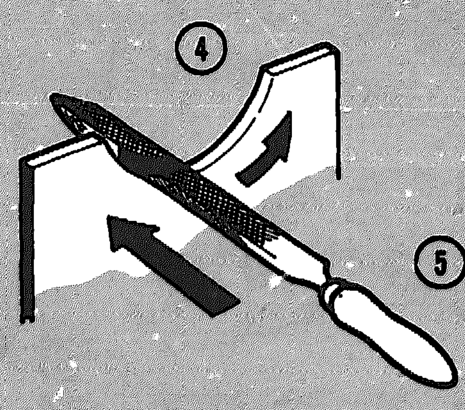
The method of filing shown here is a combination of straight and rotating movements.

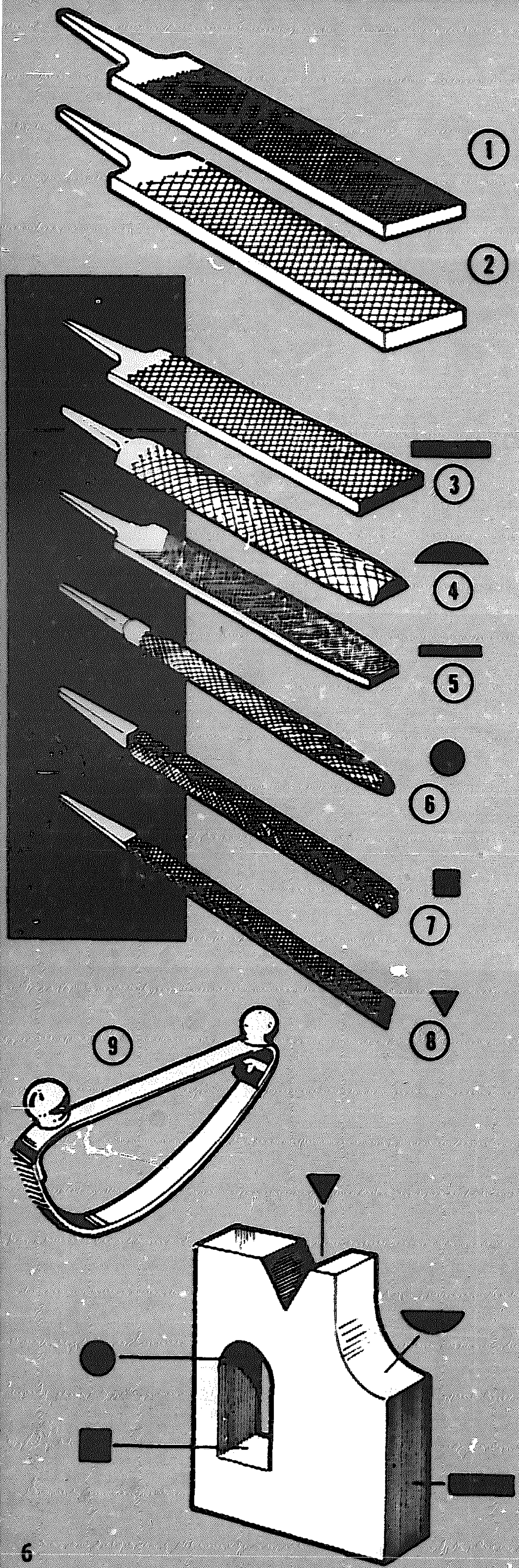


For curved inner surfaces a half-round file is used.

4
Curved inner surfaces

5
Half-round file





The coarseness of a file depends on the number of teeth per cm or inch.

1
Smooth file

A smooth file has more teeth per cm or inch than a bastard file.

2
Bastard file

Files are classified according to their sections.

3
Hand flat file

4
Half-round file

5
Flat file

6
Round file

7
Square file

8
Three-square file

9
Curved file with holder

The curved file is much used in the car industry.

Some types of work for which the various files are used.

MACHINE FILING

Rotary files are power tools and can, for instance, be inserted in the chuck of a power drill.
They come in various shapes.

1
Rotary files

2
Rotary filing disc

There are two types of filing machines; illustrated in figs. 3 and 5.

The band runs in one direction.

3
Filing machine with endless band

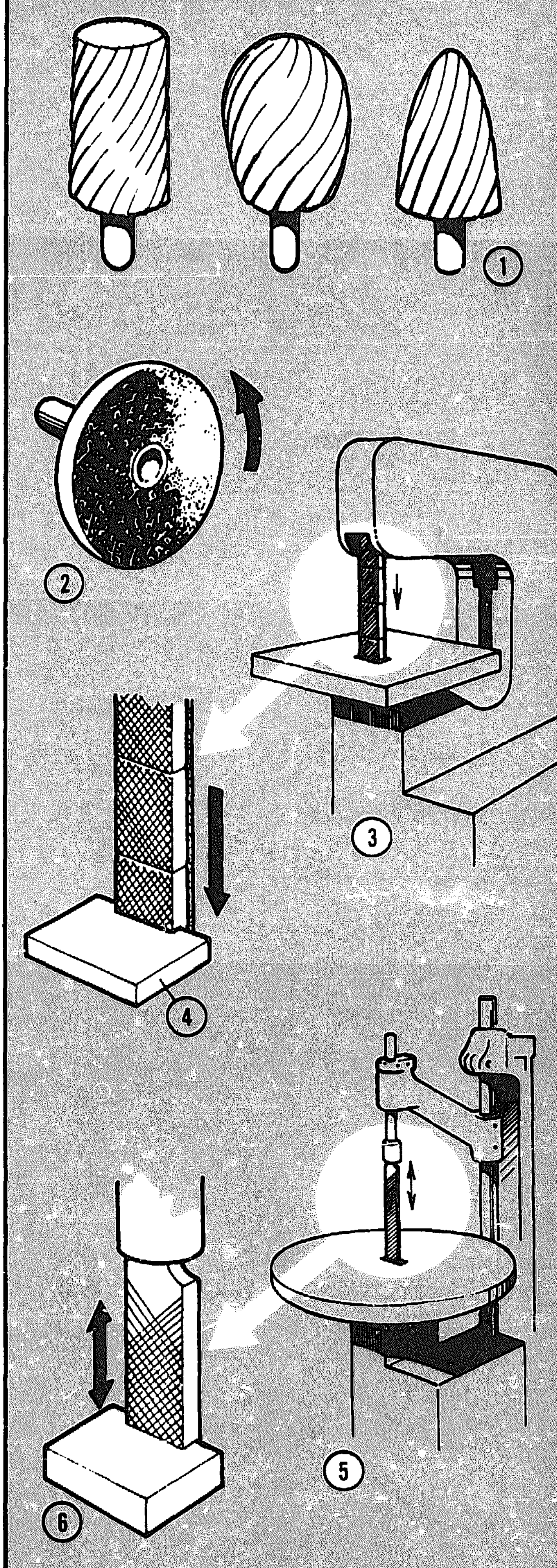
An enlarged part of the filing band with the workpiece is shown here.

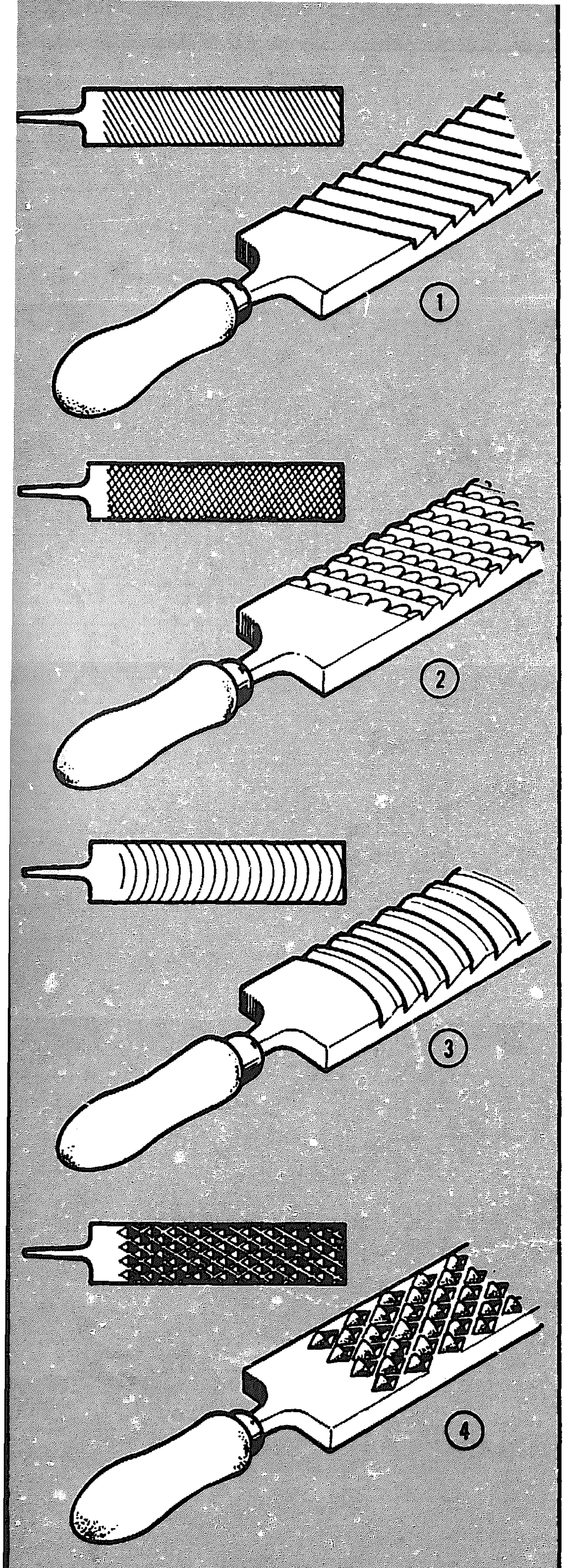
4
Workpiece

5
Filing machine with a reciprocating file

An enlarged part of the reciprocating file with the workpiece.

6
Workpiece





Some special types of files are illustrated in the figures 1 - 4.

1
File with single cut

2
File with double cut

The great number of small teeth can be clearly seen here.

3
Milled

The teeth on this vixen file are milled.

4
Rasp

For filing soft materials such as lead, tin, wood etc. a rasp is used.

The production of a work-piece showing the operational stages and the types of files used.

Hand flat file.

1
Flat outer surface

Half-round file.

2
Curved inner surface

Three-square file.

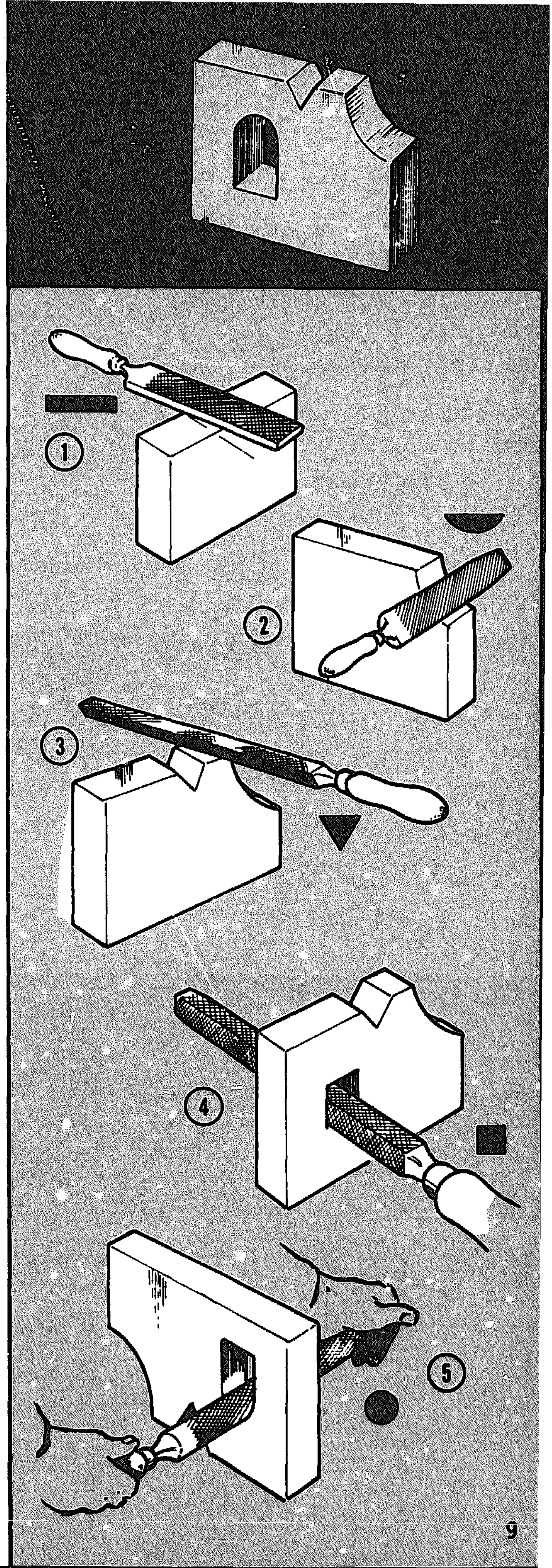
3
Triangular recess

Square file.

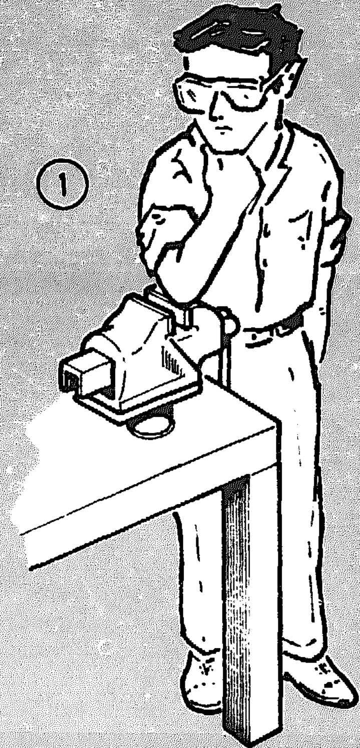
4
Square hole

Round file.

5
Rounded hole

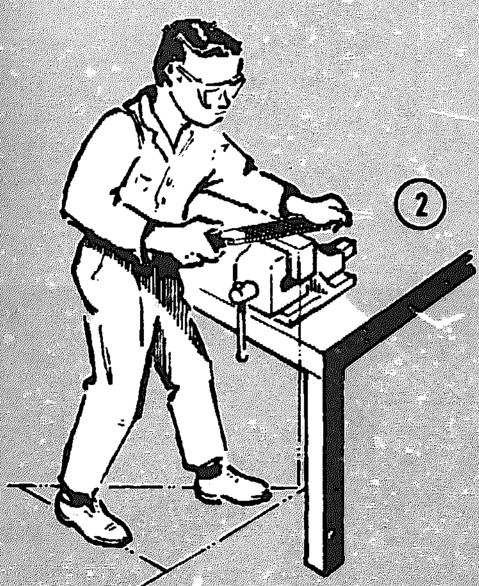


USE OF VICE



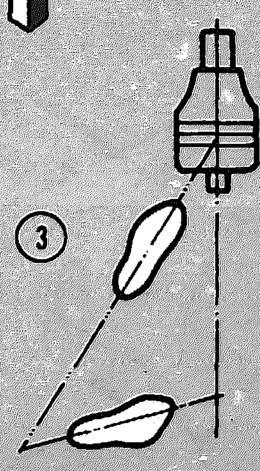
1 Height of vice

For convenient working the vice should be at the correct height. When the fist is pressed against the chin, the elbow should touch the top of the vice.



2 Working position when filing

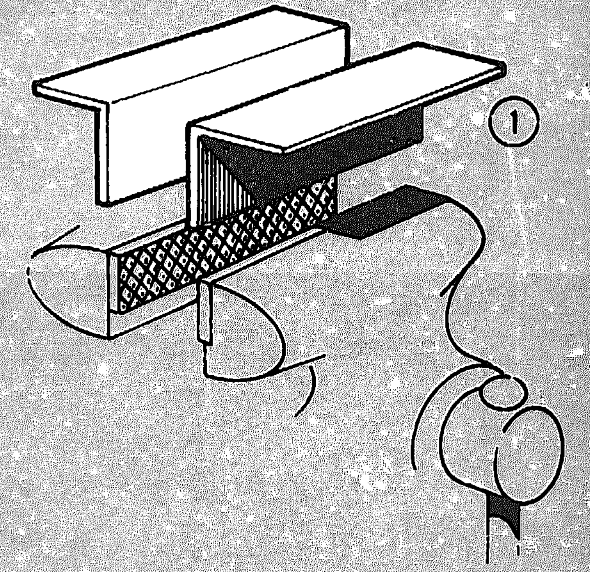
Note the position of the feet in figs. 2 and 3.



3 Position of feet

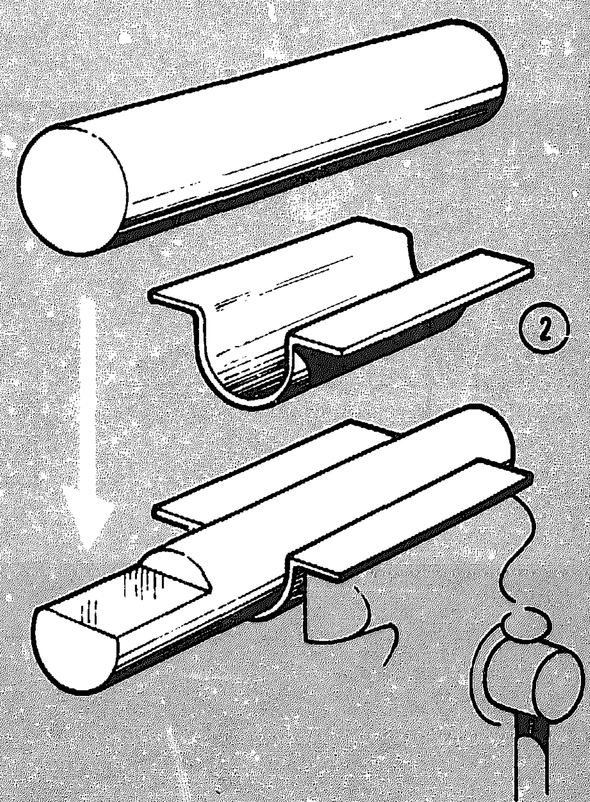
To prevent the jaws and finished surfaces from being damaged, jaw caps of some soft material should be used. Keep jaw caps meticulously clean!

1
Jaw caps



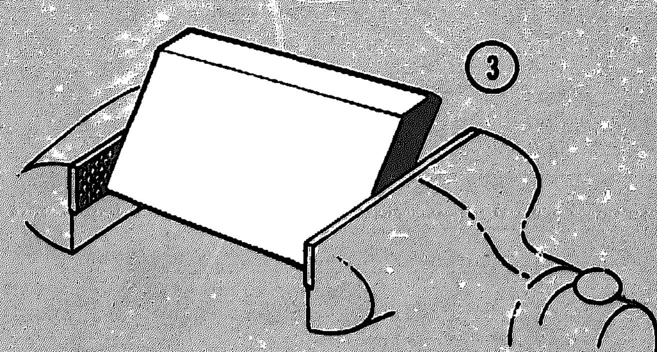
For holding round bars a special jaw cap may be used.

2
Jaw cap for shafts

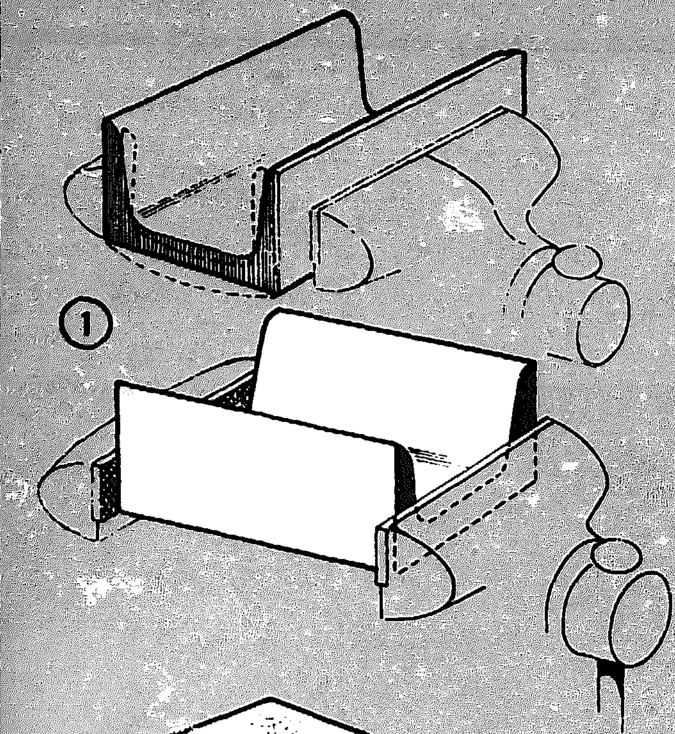


If surfaces have to be filed at an angle the work may be held in a slanting position.

3
Workpiece in a slanting position

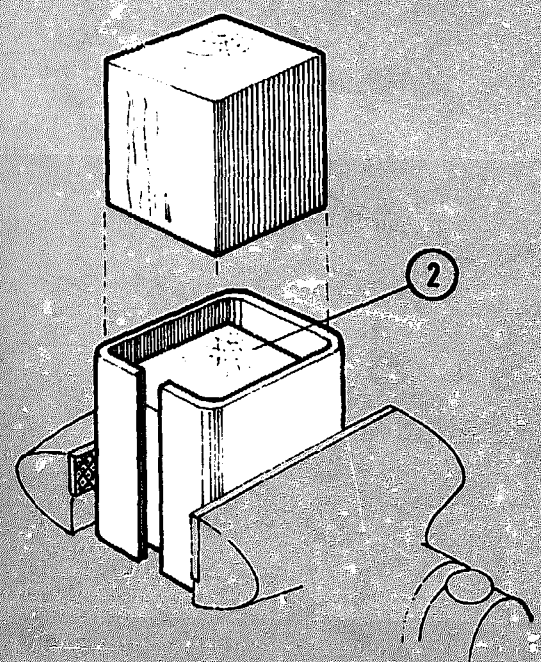


1 Channel section	To prevent distortion channel sections should preferably be held lengthwise.
2 Wooden packing	In a box-shaped component with a slot cut into one side, distortion is prevented by inserting a wooden packing.
3 Wooden backing piece	Thin materials are mounted between tacks on a wooden packing, but the heads of the tacks must not project above the material.



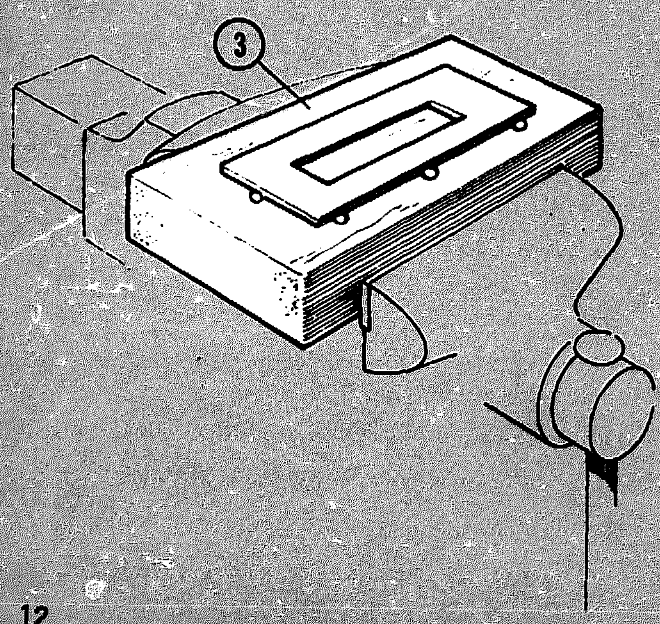
1
Channel section

To prevent distortion channel sections should preferably be held lengthwise.



2
Wooden packing

In a box-shaped component with a slot cut into one side, distortion is prevented by inserting a wooden packing.



3
Wooden backing piece

Thin materials are mounted between tacks on a wooden packing, but the heads of the tacks must not project above the material.

A recently filed surface should not be touched by hand or filing will be made more difficult.

1
Do not touch!

Scale is removed with the edge of an old file.

2
Removing scale

In the course of time filings will clog between the teeth of the file.

3
Clogged file

These filings may be removed with a file brush.

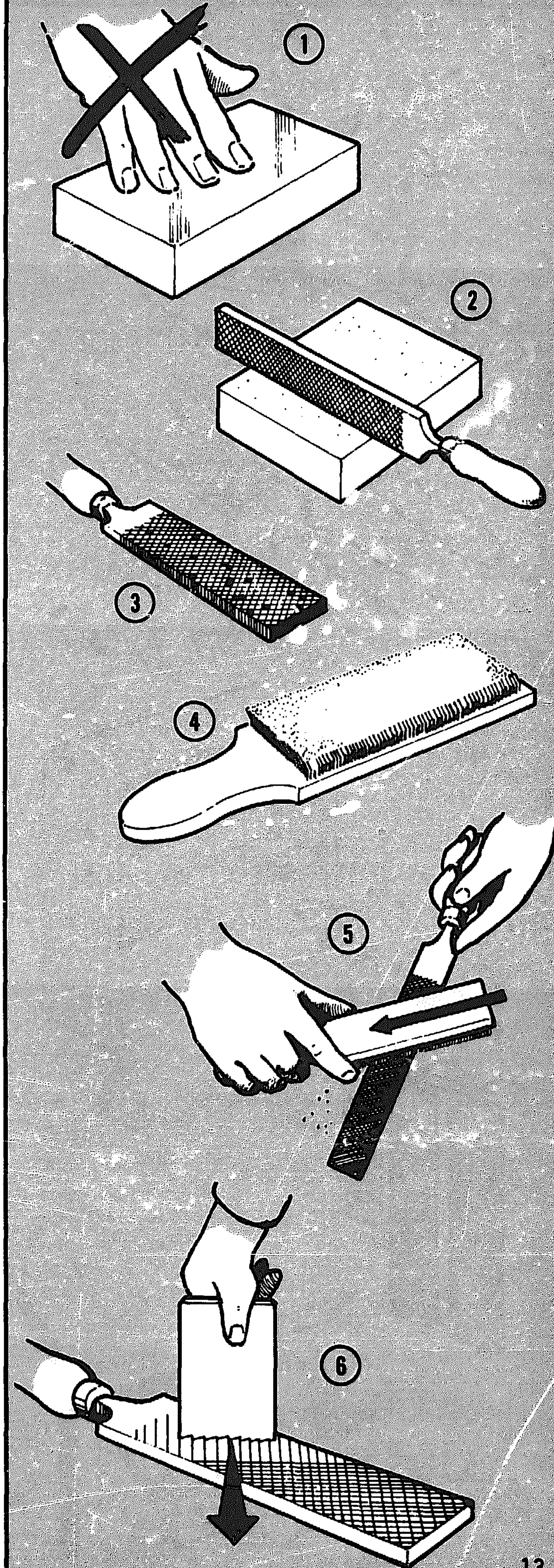
4
File brush

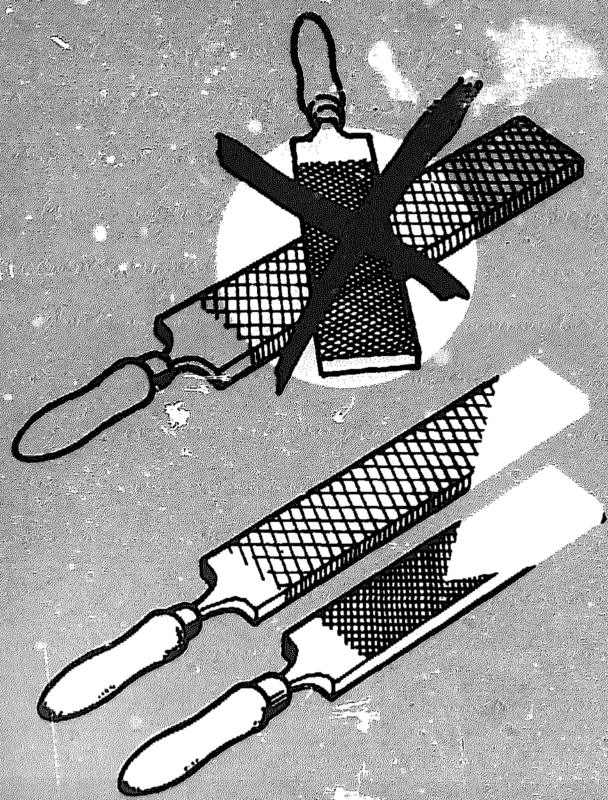
The file brush is not recommended for new files, because the strong steel wires of the brush would quickly wear off the keen edge on the new file teeth.

5
Brushing a file

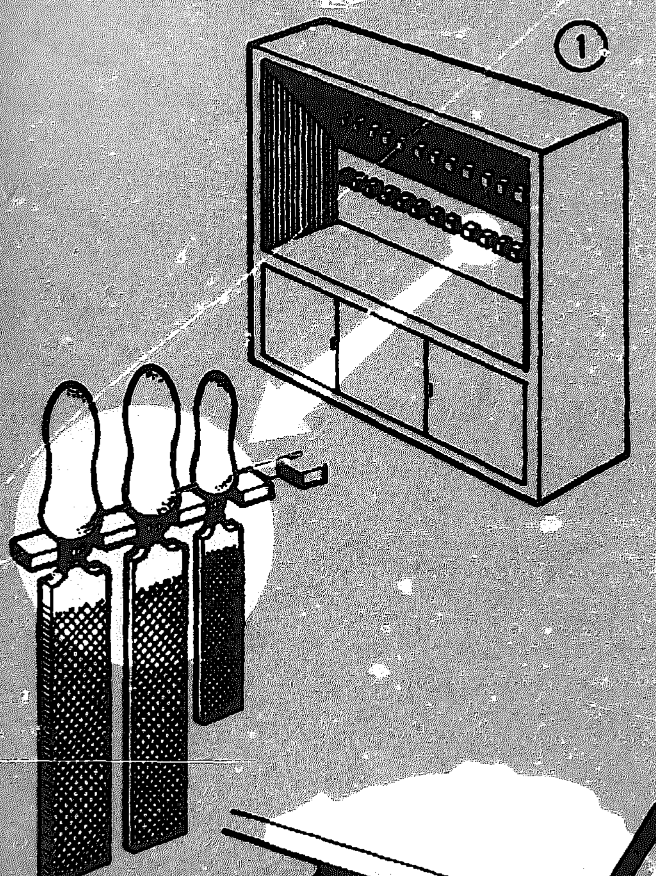
Instead, a piece of soft material such as brass may also be used for this purpose. This cleaning should be frequently repeated.

6
Use of soft material



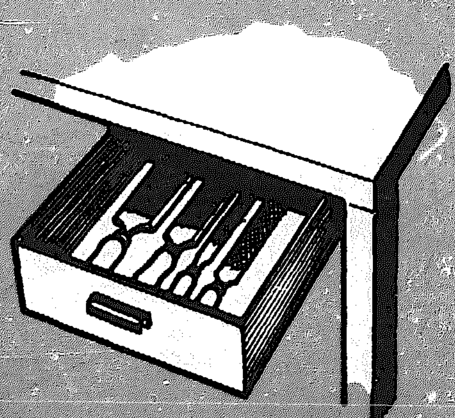


Never place files on top of each other! Keep them apart!



1
File storing cabinet

For storing files, special cabinets are very useful.



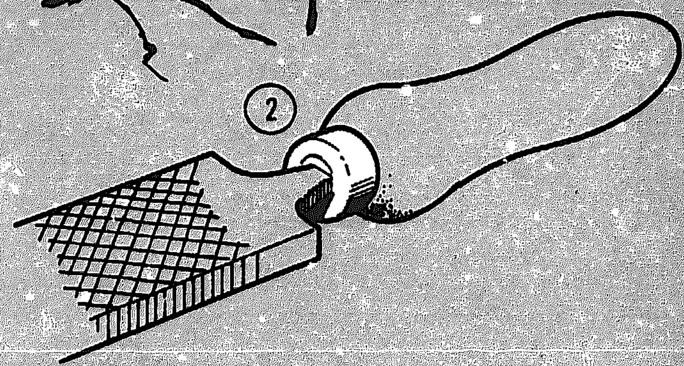
When stored in drawers, files should be kept apart.

Wear goggles when filing.

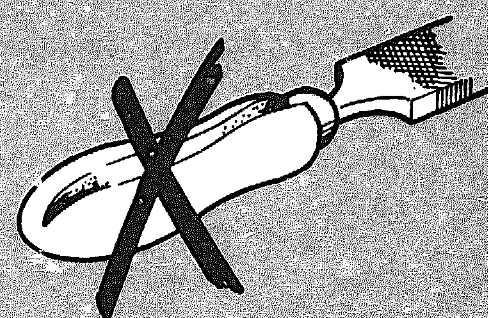
1
Goggles

Never use a file without handle. The handle should be fitted with a ferrule to prevent it from cracking and splitting.

2
Steel ferrule



Never use cracked file handles.

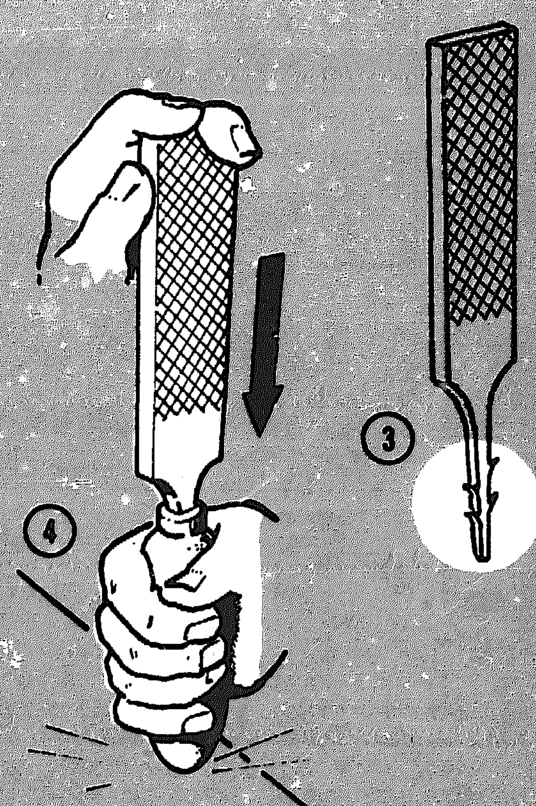


File handles will fit better when the tang has been burred beforehand. The tang is heated and provided with some burrs by means of a cold chisel.

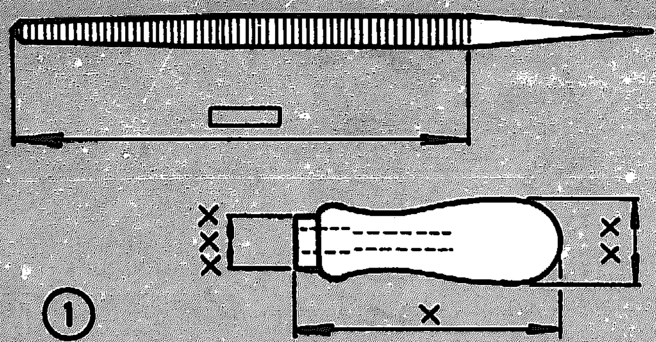
3
File with burred tang

Drive on the handle as illustrated in fig. 4. This method prevents splitting beyond the ferrule. The burrs will stick into the wood.

4
Correct way of fitting a handle



1

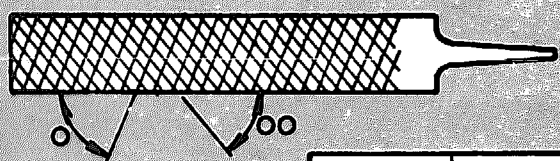


	X	XX	XXX
4"	80 mm	20 mm	5 mm
6"	100 ..	26 ..	7 ..
8"	110 ..	28 ..	9 ..
10"	120 ..	30 ..	12 ..
12"	130 ..	32 ..	16 ..

1
Sizes of file handles

Use a handle of the right size. Sizes fitting different files are given in the table.

2

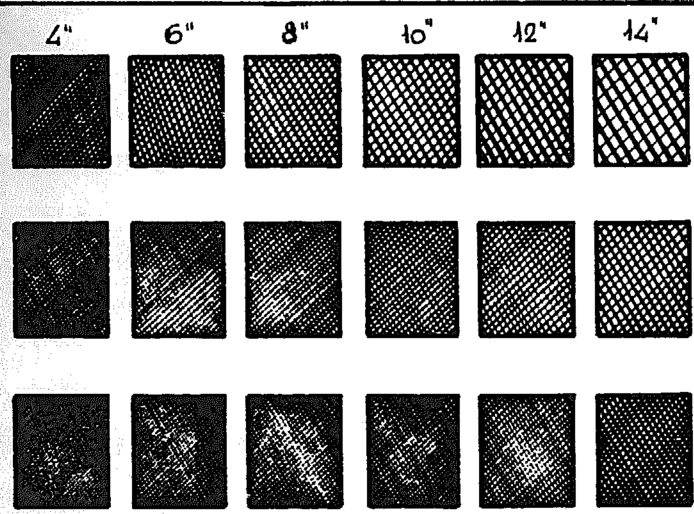


O	OO
77°	45—55°
67°	45—55°
55°	45—55°
71°	54°

2
Angles of file cuts

In this table the angles of file cuts are given.

3



3
Degrees of smoothness

These squares show the cuts on files with different degrees of smoothness.

Bastard (No.1)

Top row: bastard files.

Second cut (No. 2)

Middle row: second cut files.

Smooth file (No. 3)

Bottom row: smooth files.

4

L	4" 100 mm	6" 150 mm	8" 200 mm	10" 250 mm	12" 300 mm	14" 350 mm
No. 1	14	11	10	9	8	7.5
No. 2	22	18	16	14	12	11.5
No. 3	31	25	22	20	18	16

4
Number of teeth

Finally a table giving the number of teeth per cm for different smoothnesses.
L = length.

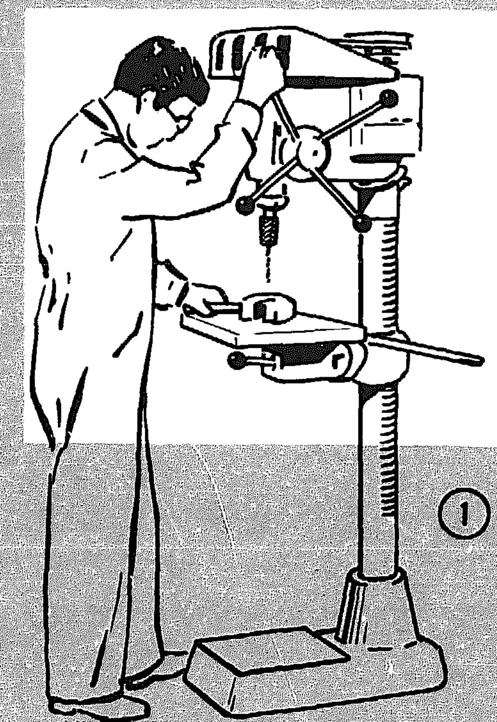
ISBN 90 217 1015 3 FILING

INTEMS PICTORIAL SYSTEM

DRILLING

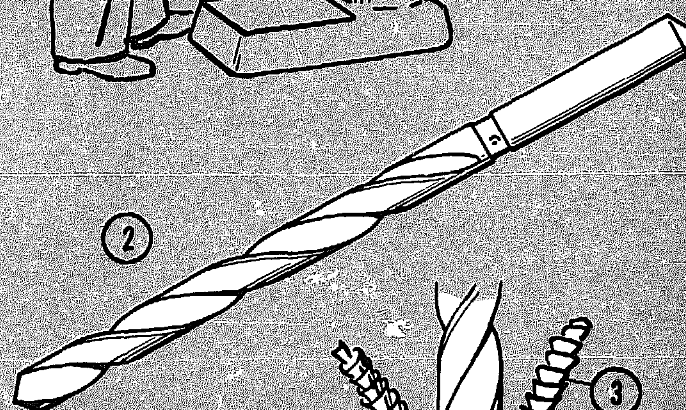
Drilling is an operation for making round holes.

1
Drilling with drilling machine



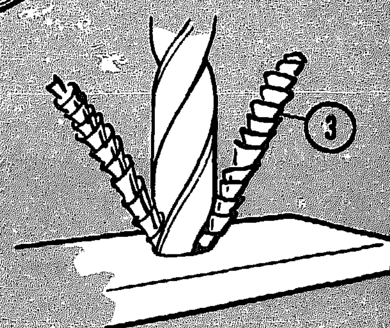
The twist drill, shown here, is held in the drilling machine.
When the machine is started the drill turns.

2
Twist drill



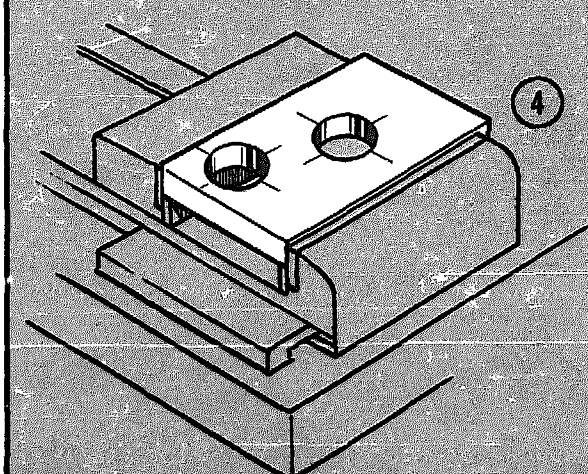
When the drill is pressed on to the work the material will be cut away. Two curling chips are formed.

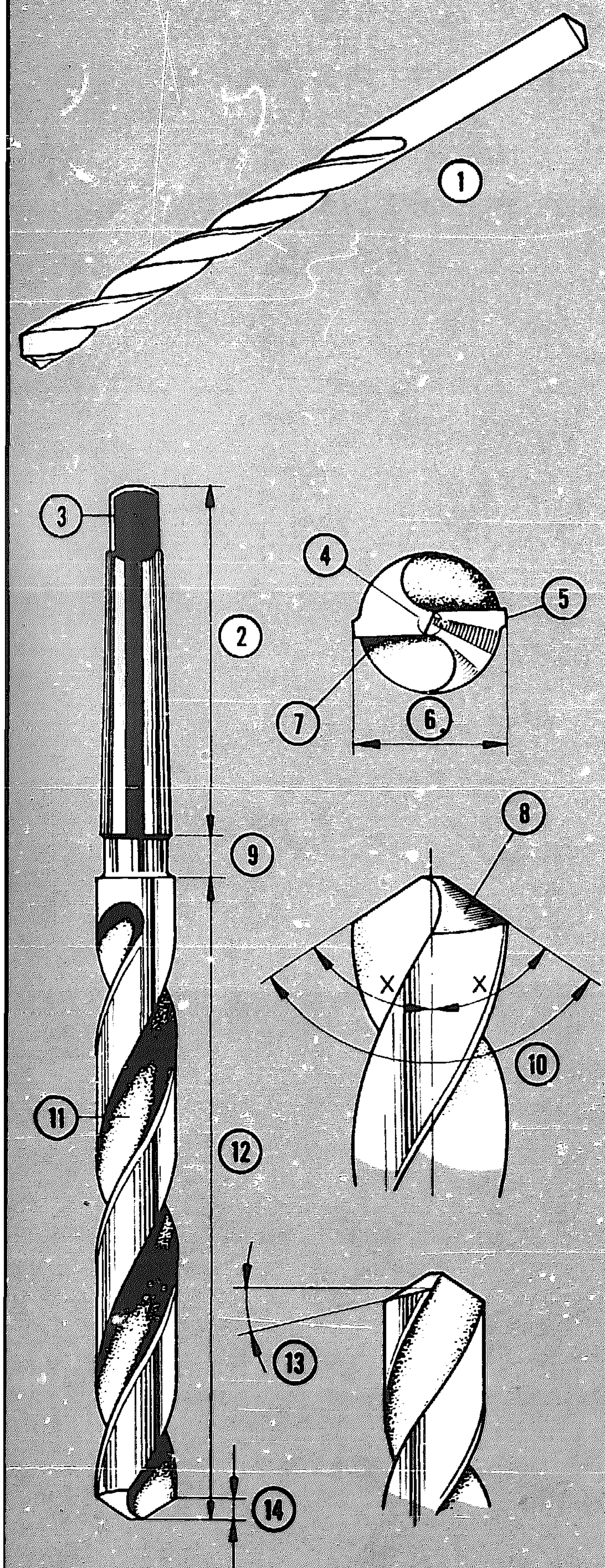
3
Chips



The material has been cut away by the drill and two holes have been produced.

4
Result





1
Drill with parallel shank

We see two parts on the twist drill. The grooved part (the grooves are called flutes) is called the body. The smooth part is called the shank.

2
Taper shank
3
Tang
4
Core or web
5
Land
6
Body clearance diameter
7
Cutting edge (also called lip)
8
Point angles at X equal
9
Recess

Drills may have parallel shanks (fig. 1) or taper shanks (fig. 2).
Terms used in connection with twist drills are given in the drawings.

10
Included point angle
11
Flute
12
Body

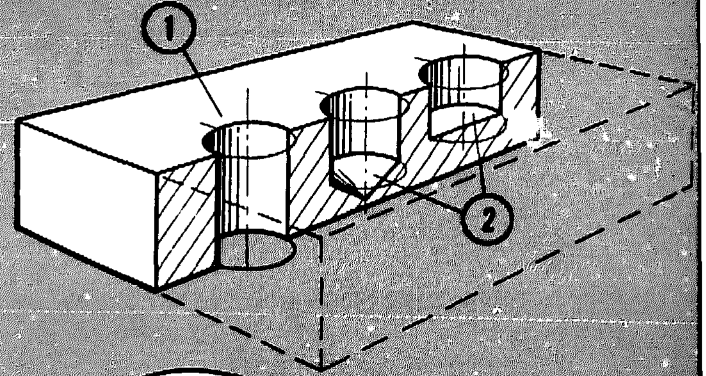
The included point angle is usually 118° for general use.

13
Lip clearance angle
14
Point

Drilled holes may be either through holes or blind holes.

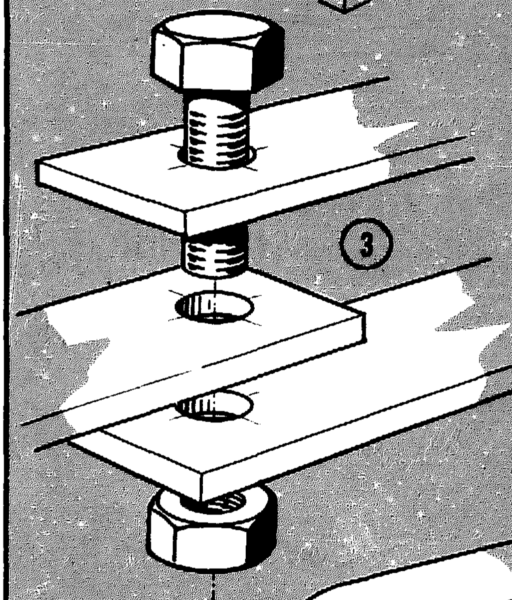
1
Through holes

2
Blind holes



Holes may be drilled for passing bolts or rivets through them.

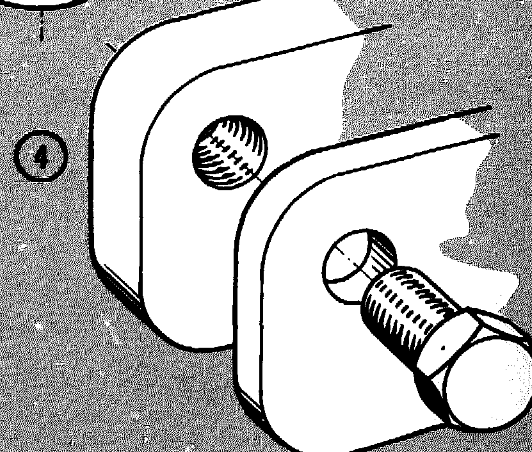
3
Bolt holes



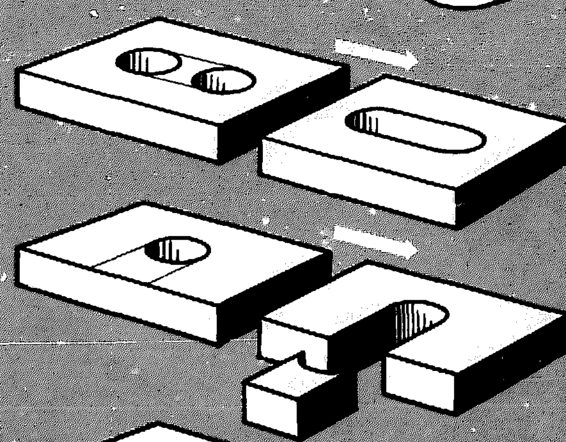
Holes are also frequently drilled as a preliminary to further operations such as:

4
Tap holes

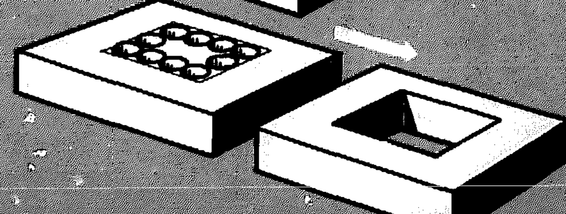
Screw-thread tapping (fig.4).



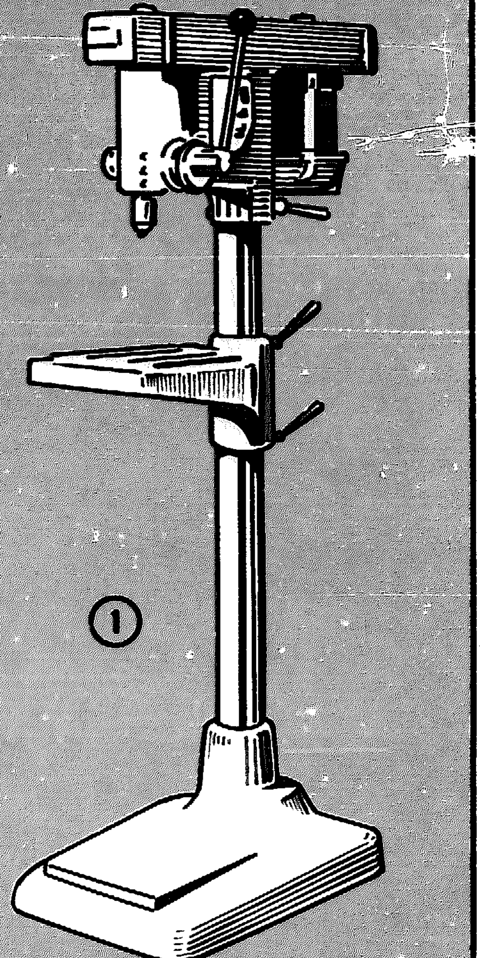
Making slots or inner rounds.



Rough shaping when material has to be removed.

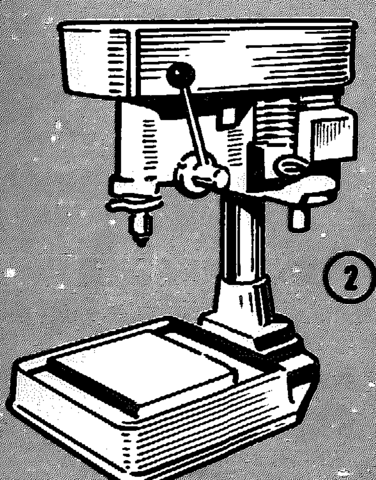


There are various types of drilling machines.



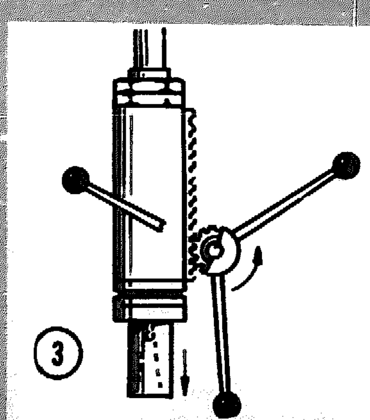
1
Vertical spindle driller

The vertical spindle driller, shown here, has a table which can be moved upward and downward along the spindle. The head unit, which is in a fixed position on top of the spindle, contains the driving mechanism.



2
Bench drill

The bench drill is fastened to the work bench or to a special base.



3
Feed

The downward movement of the drill is called the feed.
It is effected by means of a handle.

The transmission from the electric motor to the drill is usually by means of a V-belt. This is an endless belt with a V-shaped section.

1
V-belt

All the components used for driving the drill are shown separately here.
Pulleys are fitted on the motor and on the spindle for the V-belt.

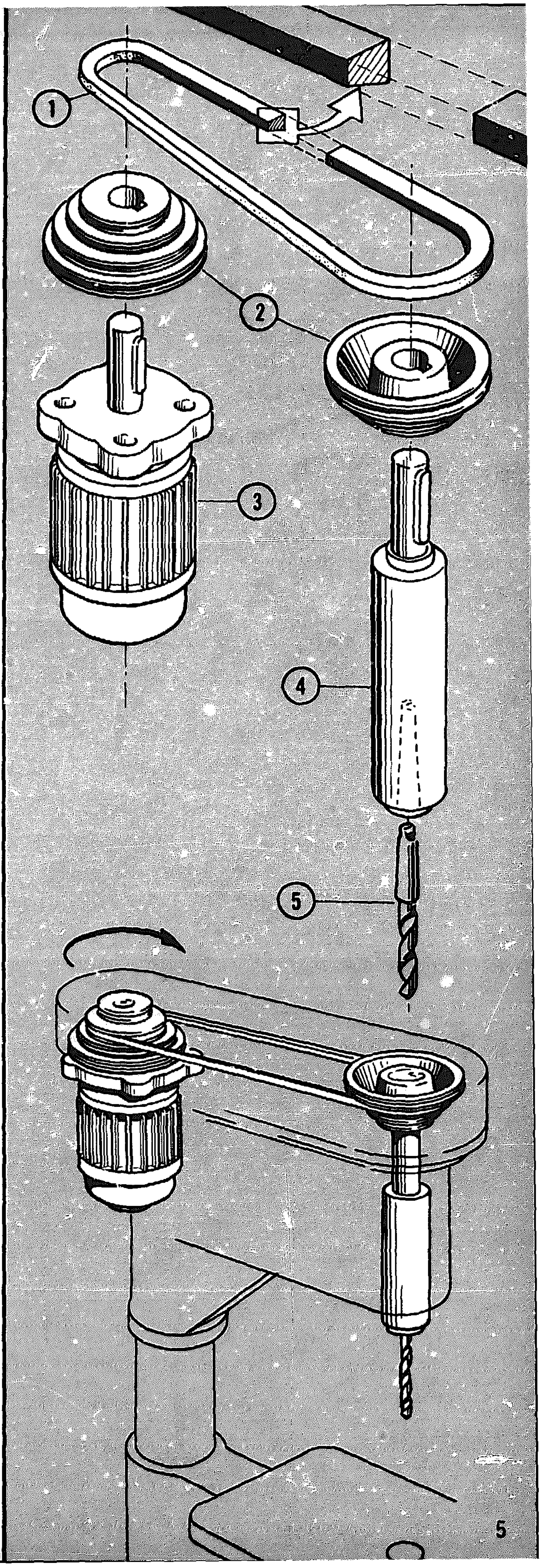
2
Pulleys

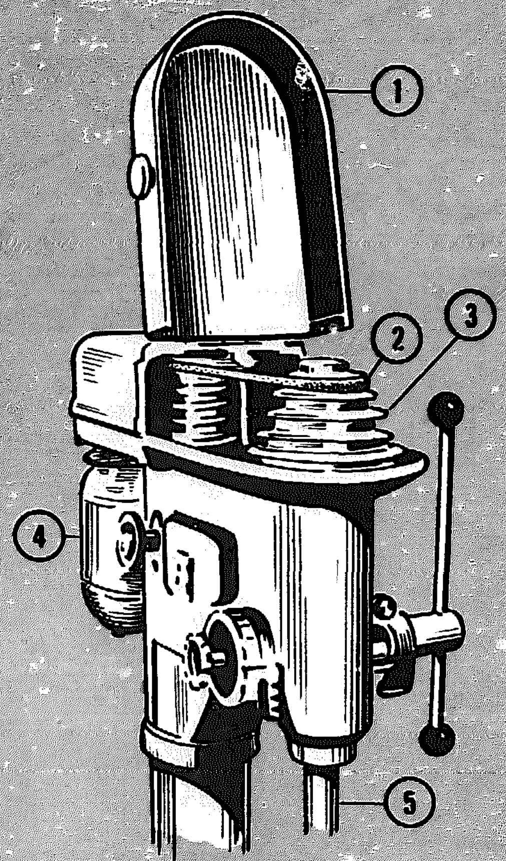
3
Electric motor

4
Spindle

When the motor is started the spindle, with the twist drill, is driven.

5
Twist drill





1
Guard

The head of a drilling machine is shown here with open guard.

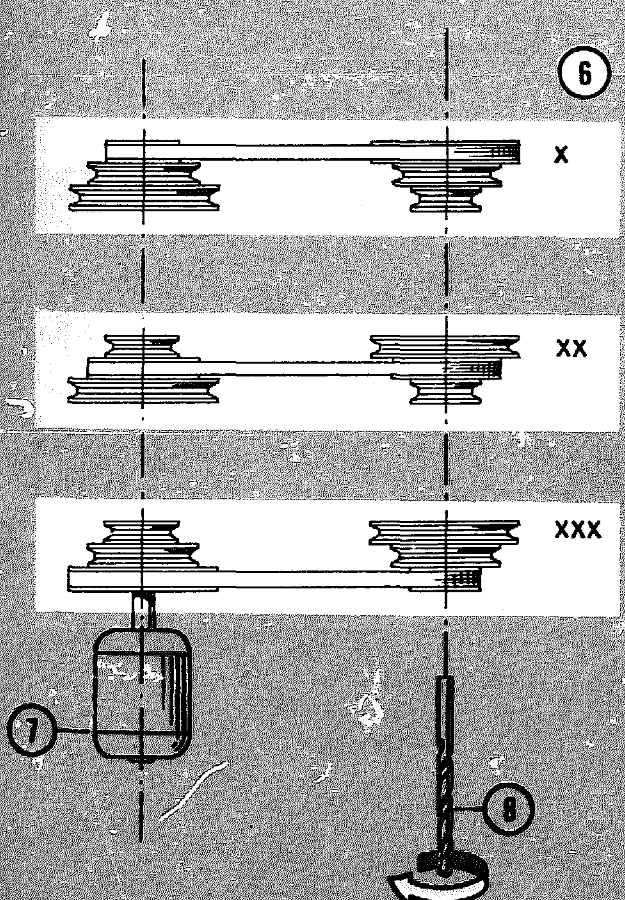
2
V-belt
3
Pulley

The two pulleys and the V-belt are clearly visible.

4
Motor

At the rear is the motor.

5
Spindle



6
Different drilling speeds

By moving the V-belt from one set of pulleys to another, different drilling speeds are obtained. The speeds are indicated on the machine.

X Drill speed smaller than motor speed.

XX Drill speed = motor speed.

XXX Drill speed greater than motor speed.

7
Motor

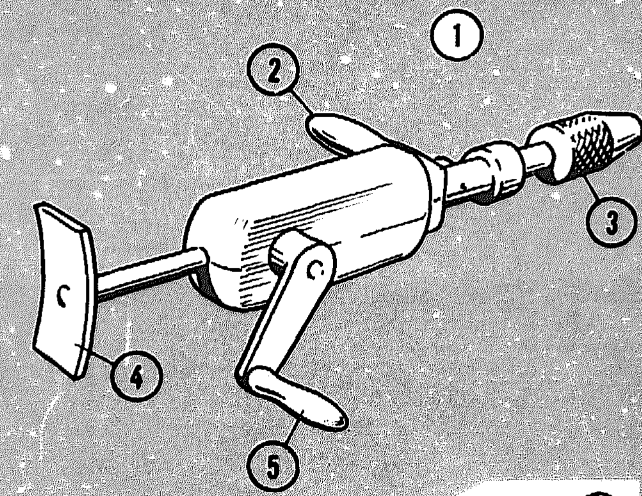
8
Drill

If the work cannot be held in a drilling machine a hand drill is used.

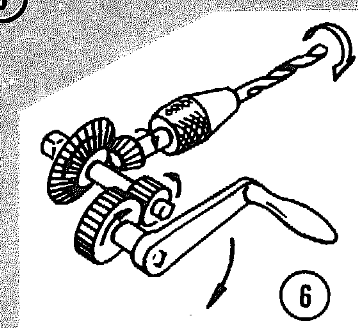
The drill shown in fig. 1 is manually operated.

The twist drill is held in a chuck.

1
Hand drill
2
Handle
3
Chuck
4
Rest
5
Operating handle

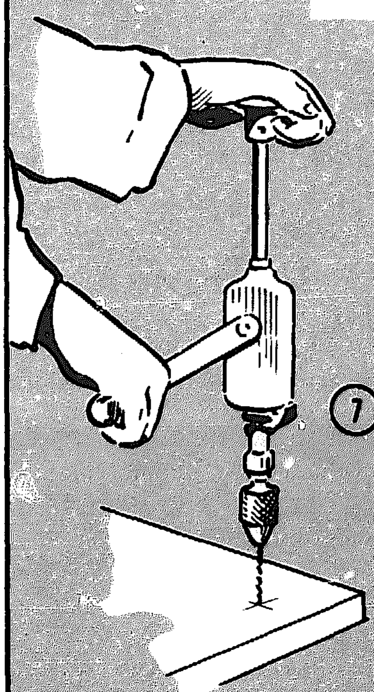


6
How the drive is transmitted



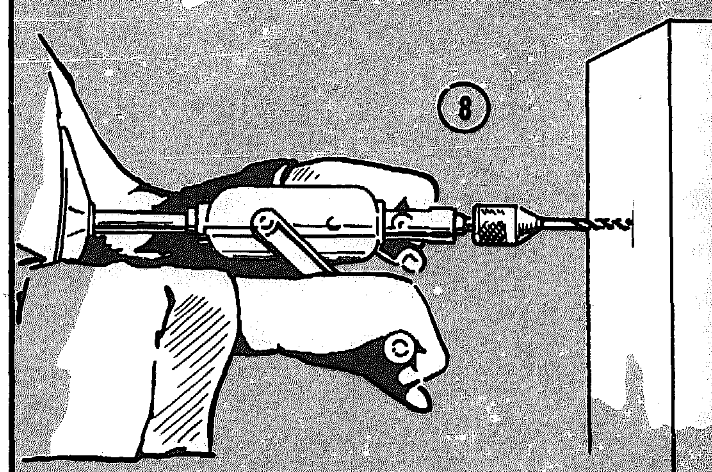
Position for vertical drilling. One hand is used for turning the operating handle and the other for pressing the drill down.

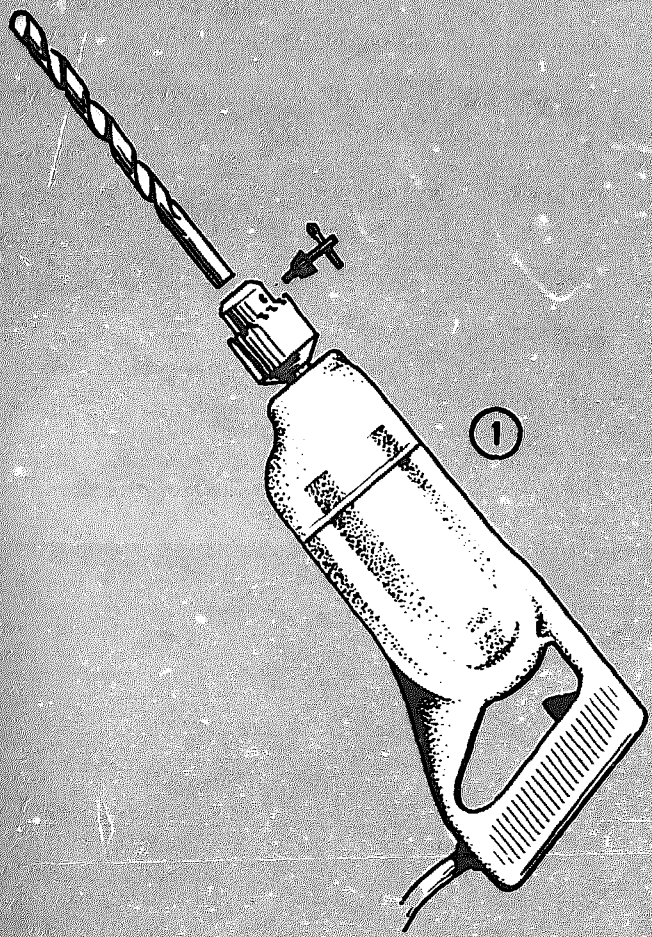
7
Vertical drilling

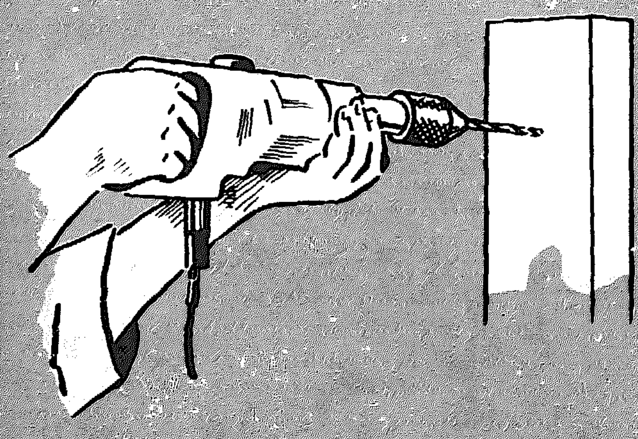


Position for horizontal drilling.

8
Horizontal drilling







1
Electrically driven hand power drill

Instead of a manually-operated drill an electrically driven hand power drill may be used. The twist drill is held in a chuck. The motor is started and stopped by pressing or releasing a button.

A twist drill may have a parallel shank or a taper shank.

1
Parallel shank drill

2
Taper shank drill

There are various other types and shapes, such as the centre drill for drilling centres in shafts.

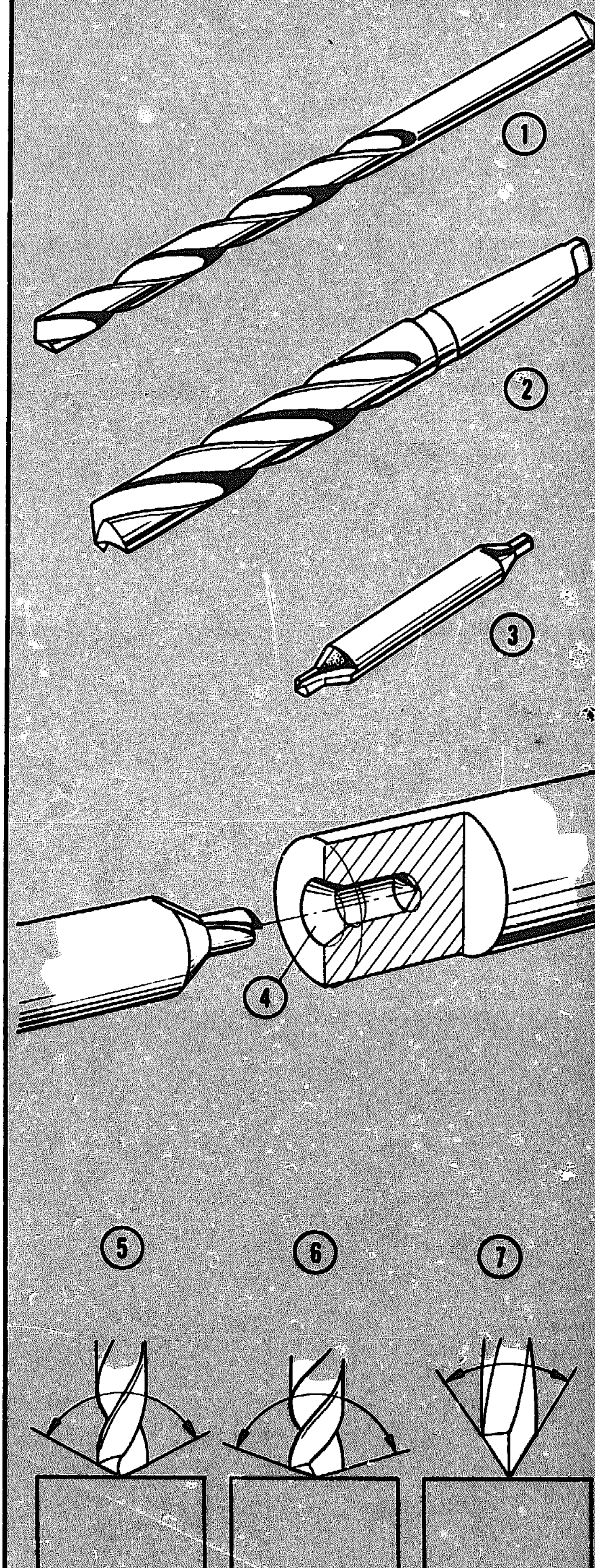
3
Centre drill

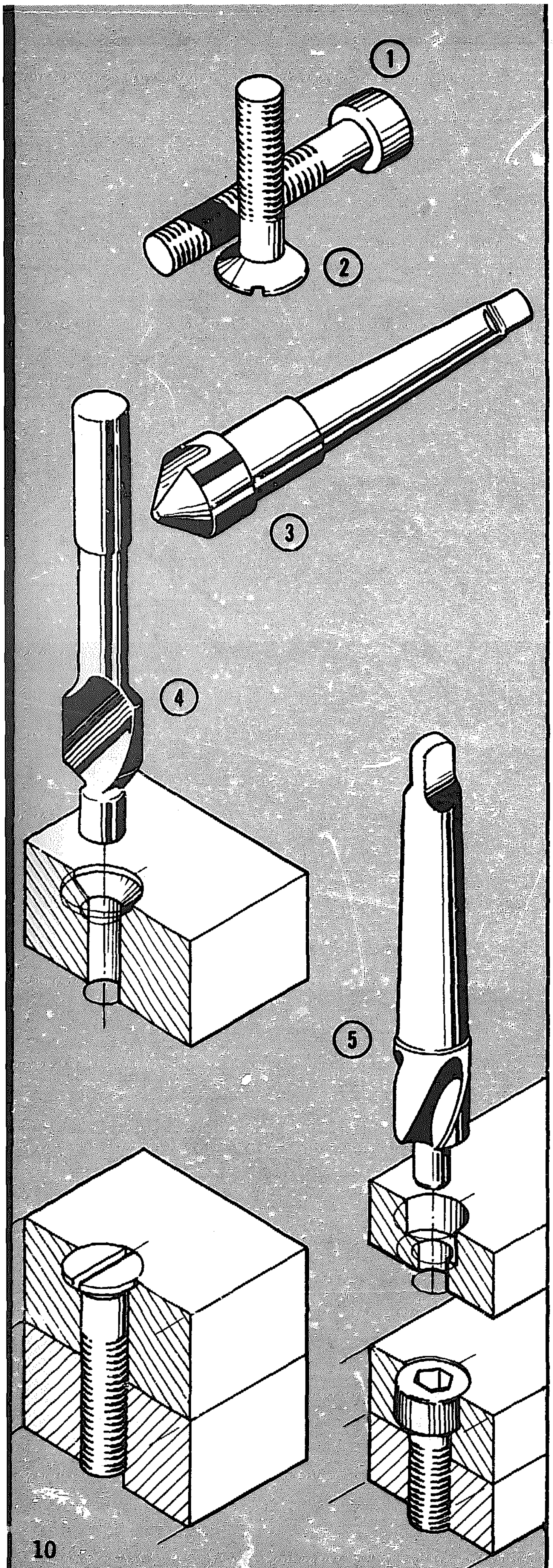
4
Using a centre drill

There are also special types of drills for different materials.
Notice the point angles.

Drills for:

5
Steel
6
Aluminium
7
Plastics





1
Screw with cylindrical head

To be able to countersink or counterbore drilled holes for screws with a round head, special drills are used.

2
Screw with countersunk head

3
Countersink

The tapered enlargement at the top of a hole for a screw with a countersunk head is made with a countersink.

4
Countersink with pilot

5
Counterbore with pilot

To counterbore a drilled hole for a screw with a cylindrical head a counterbore is used.

At the lower end of the counterbore there is usually a cylindrical part to guide the counterbore in the drilled hole.

A taper shank drill fits into the spindle socket.

1
Spindle

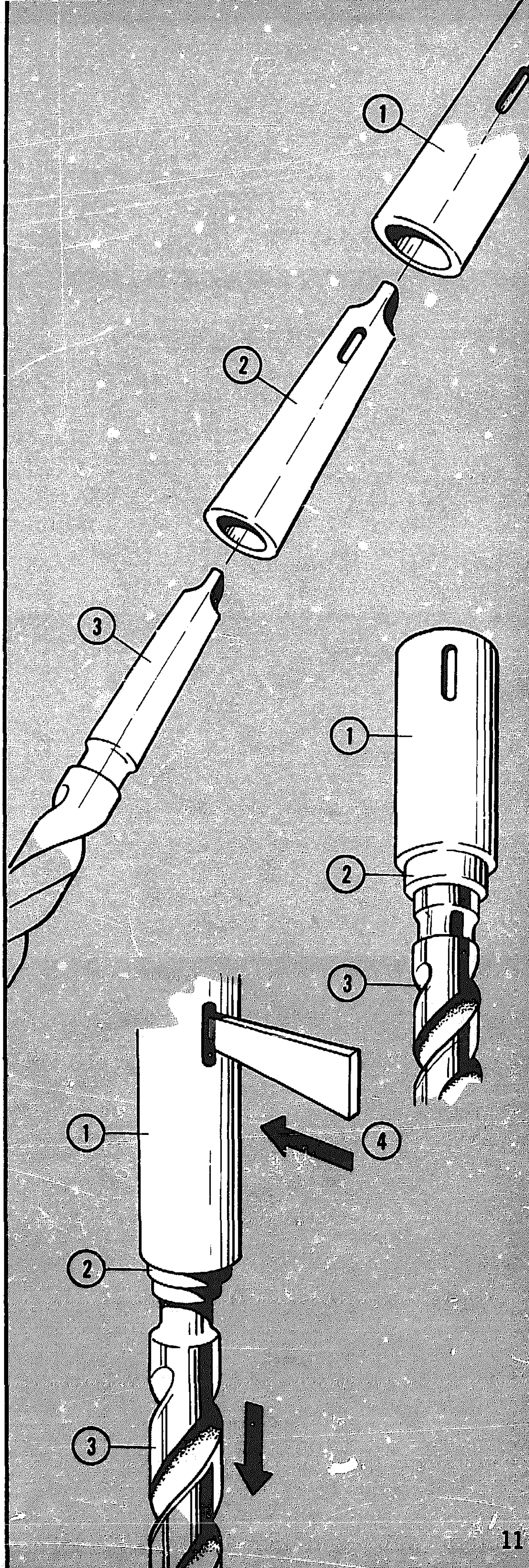
Small drills are held by means of an arbor (also called sleeve).

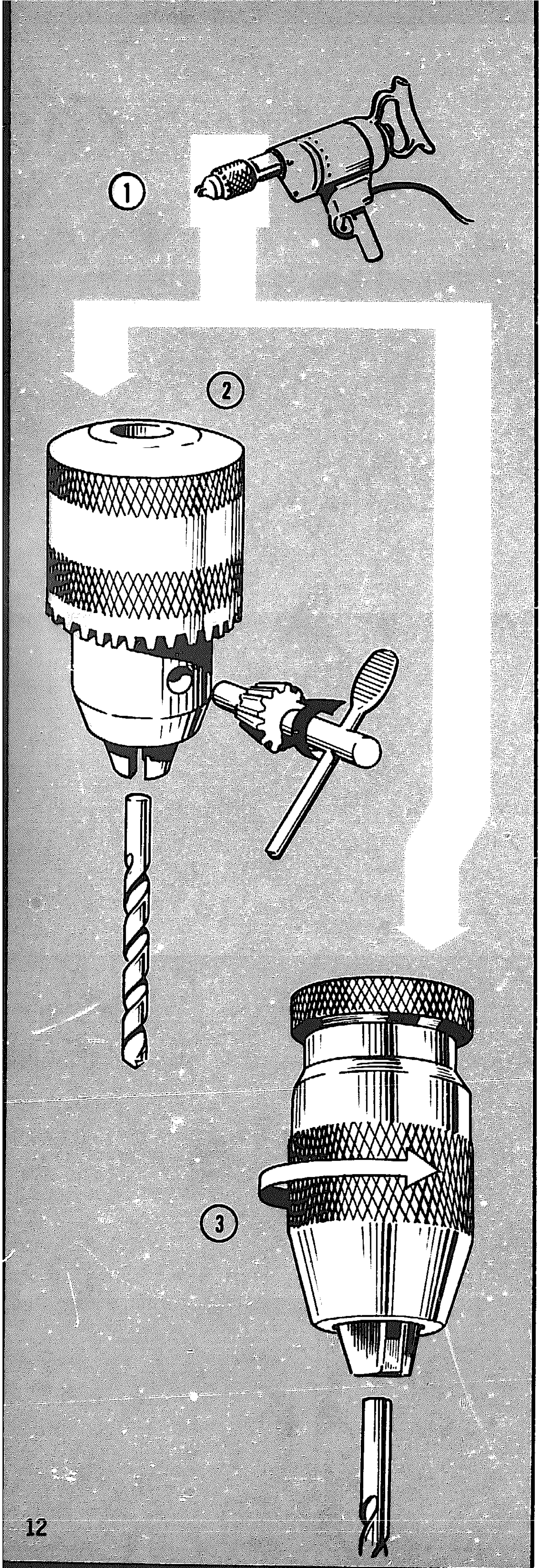
2
Arbor
(sleeve)

3
Drill

The drill is removed by means of a drill drift inserted through a slot in the spindle.

4
Drill drift





1
Chuck

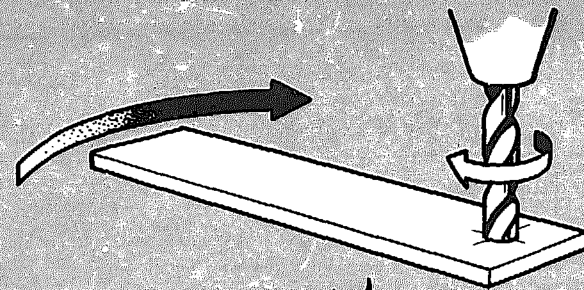
A different system is needed for holding a parallel shank type drill.

2
By means of a pinion key

In the first system shown the drill is held by three jaws which are tightened or loosened by means of the pinion key.

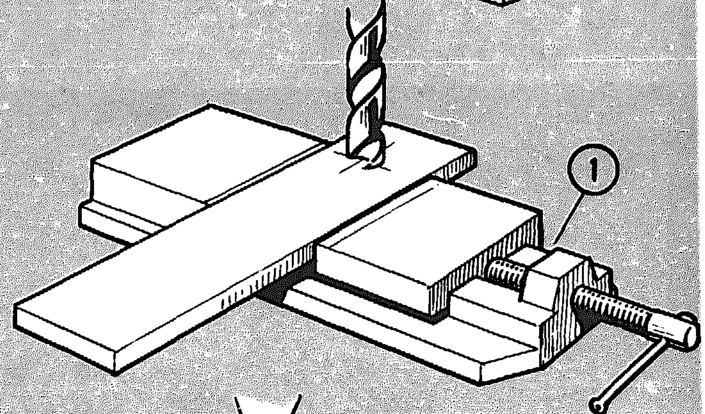
3
By means of a knurled ring

In the second system the chuck jaws are adjusted by turning the knurled outer ring.



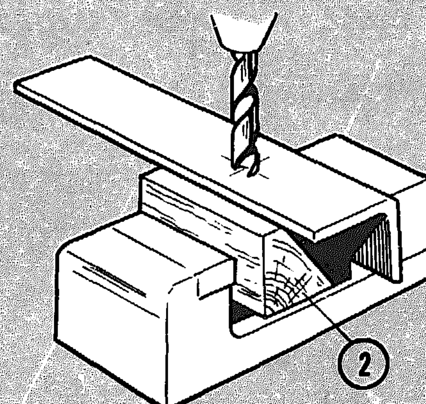
To prevent the work from being hurled round by the turning drill it must be clamped.
Clamping is necessary to prevent accidents and for keeping the workpiece in its place.

1
Machine vice



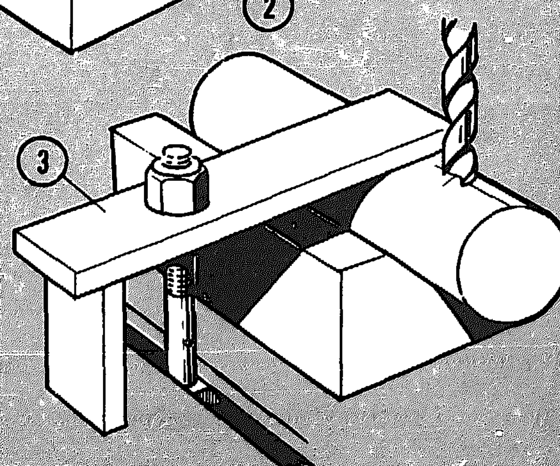
If necessary use pieces of wood under the work (packings) to prevent the vice or table from being damaged by the drill.

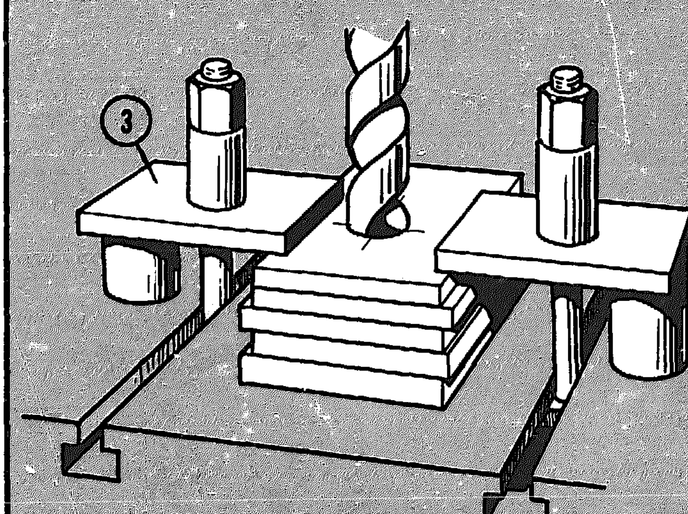
2
Wooden packing

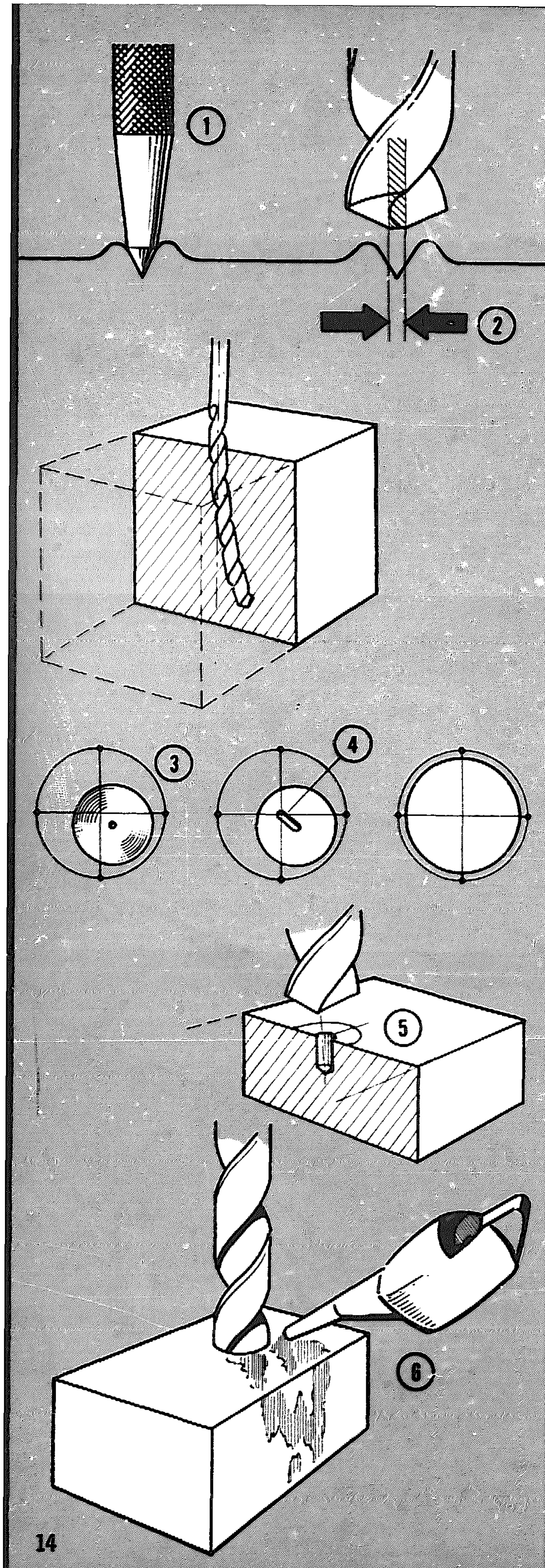


The work may be held in a machine vice (fig. 1) or clamped on the drilling table by clamps or dogs (fig. 3).
In the latter case the screw holding the dog should be as near the work as possible.

3
Dog



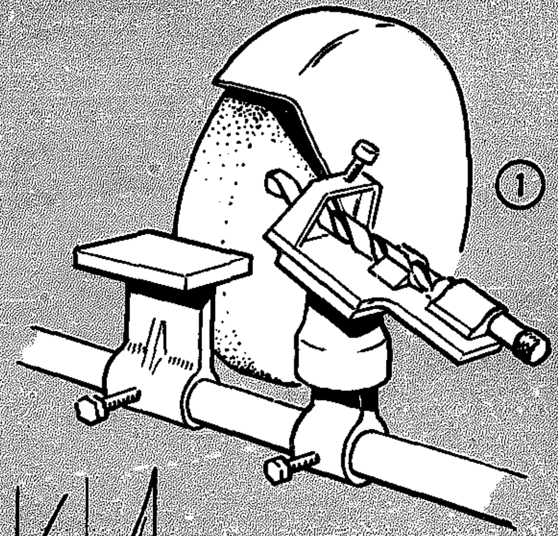




1 Centre punch	Before drilling is started a centre is punched. This centre should be wider than the drill core.
2 Core of drill	
	If a drill is inaccurately ground the chances are that it will run out of centre. This is most likely to happen with thin drills.
3 Decentralised drill 4 Cut groove	If the decentralising occurs at the beginning it may be remedied by cutting a groove in the direction into which the drill is to be moved.
5 Pre-drilled	Large holes should be pre-drilled, i.e. a smaller hole is first drilled.
6 Cutting lubricant	Always use a cutting lubricant where this is specified.

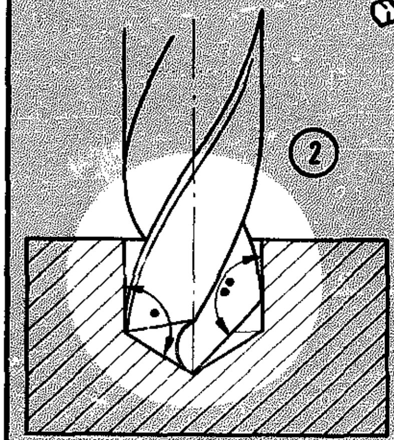
To keep a drill in good working condition correct re-sharpening is of the utmost importance.
Re-sharpening should be done on a grinding wheel, if possible with the drill held in a special holder.

1
Drill point grinding device

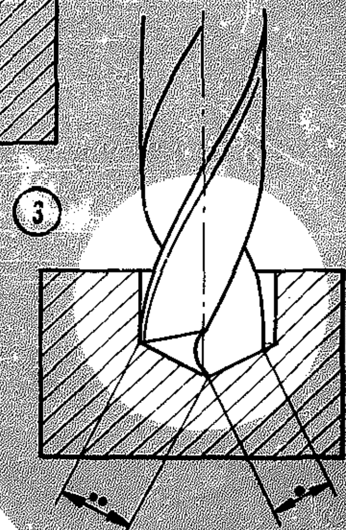


The following point grinding inaccuracies may occur:

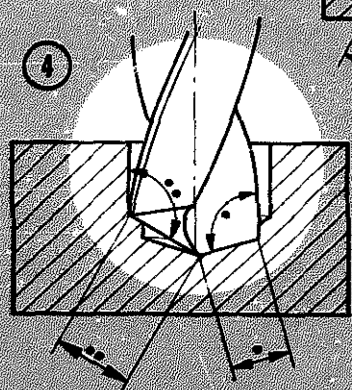
2
Unequal point angles



3
One lip longer than the other

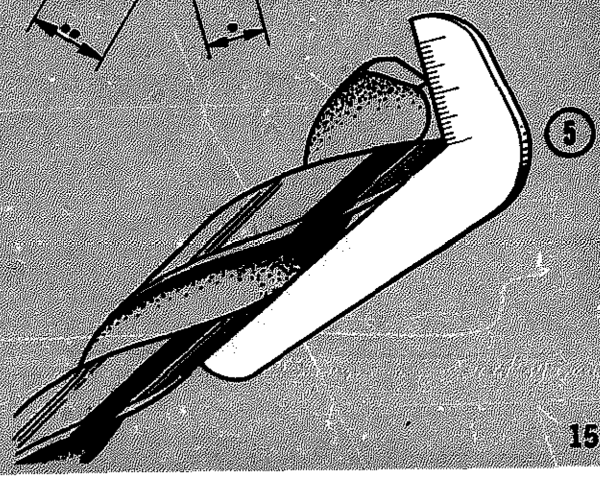


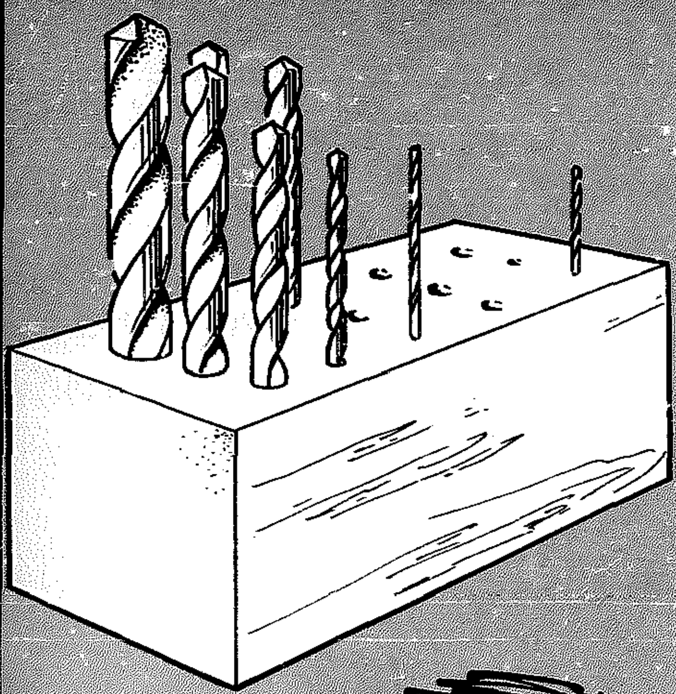
4
Unequal point angle and one lip longer than the other



This may be tested with a point angle gauge.

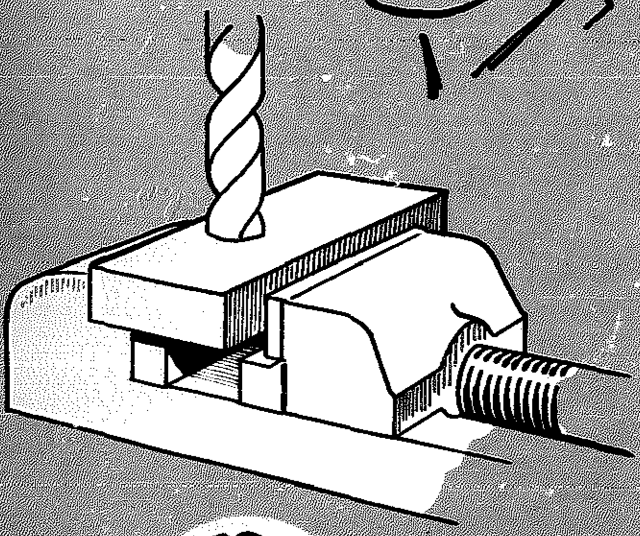
5
Point angle





To protect the drills from being damaged they are kept in blocks with the proper holes drilled into them.

Always wear goggles when drilling.



The work should always be clamped.

And... remember that a hair cut is less painful than having it torn out by a drilling machine spindle!

ISBN 90 217 1016 1 DRILLING

INTEMS PICTORIAL SYSTEM

SAWING

1
Sawing

The saw moves to and fro, making a reciprocating movement. At the same time a downward pressure is exerted on the saw, but only with the to movement.

2
Blade

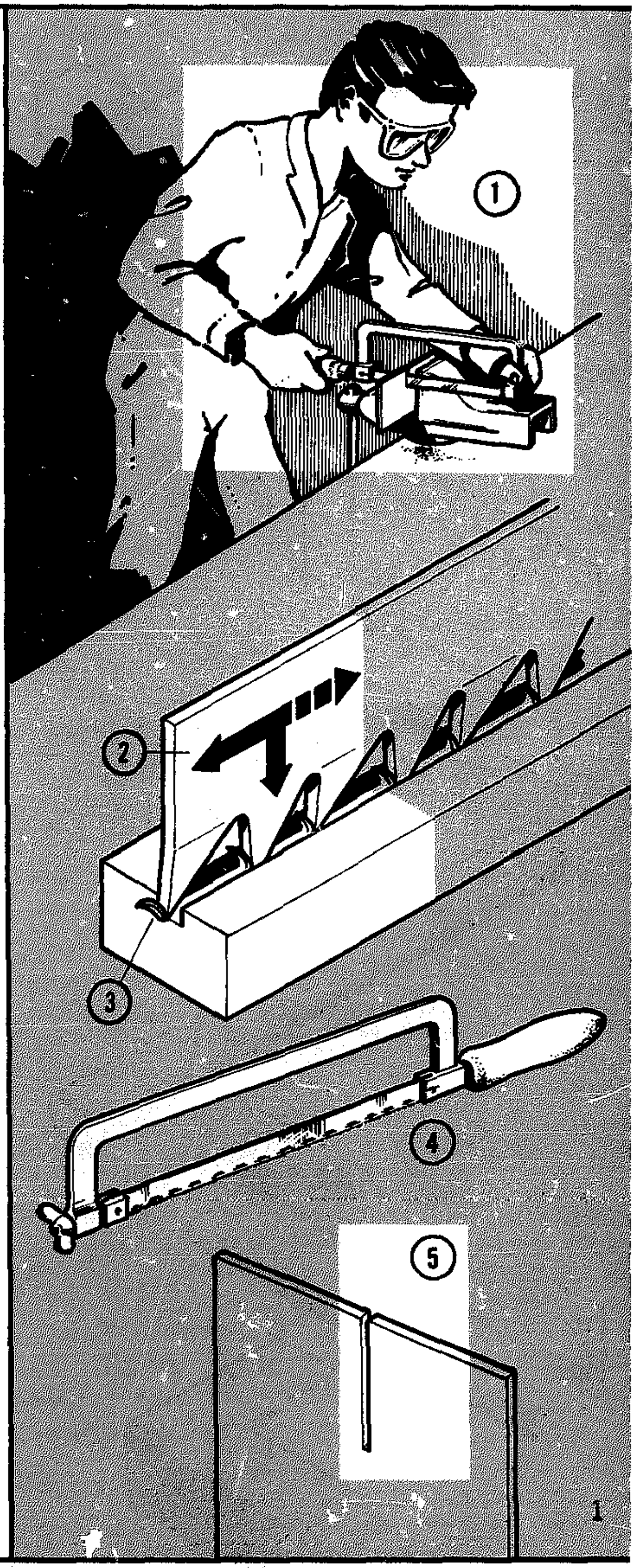
On the blade of the saw are teeth. These teeth cut small chips from the material while sawing.

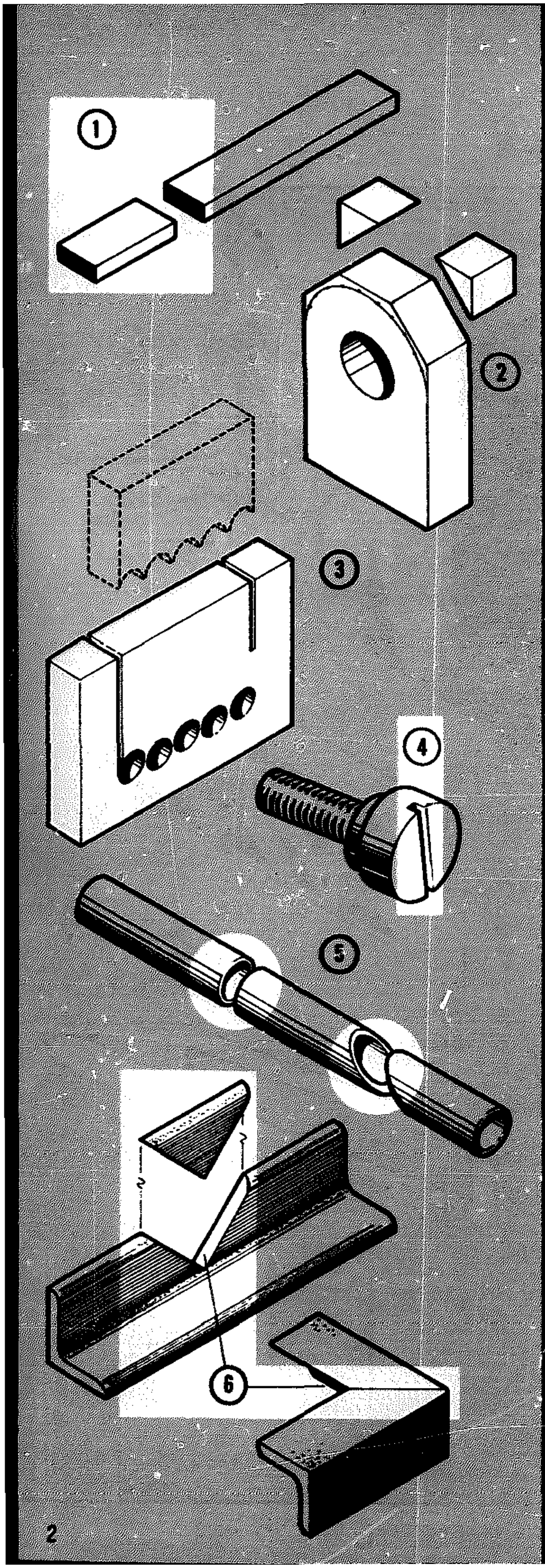
3
Chip

4
Hack saw

5
Cut

By sawing a cut is left in the material.





	Sawing has many uses.
1 Shortening	Shortening material.
2 Rough shaping	Rough outside shaping.
3 Rough shaping	Rough shaping of recesses combined with drilling.
4 Slotting	Slotting in screw heads.
5 Cutting off	Cutting off pipes.
6 Mitres	Mitring steel sections.

When we study a saw blade we see that it is thickest where the teeth are.

The reason is that the teeth have been slightly bent outwards, alternately to the left and to the right.

This is to prevent the saw blade from getting hot and jamming in the cut.

Hacksaws with fine teeth have a wavy cutting edge.

The set of a saw may be regular (standard) or wave.

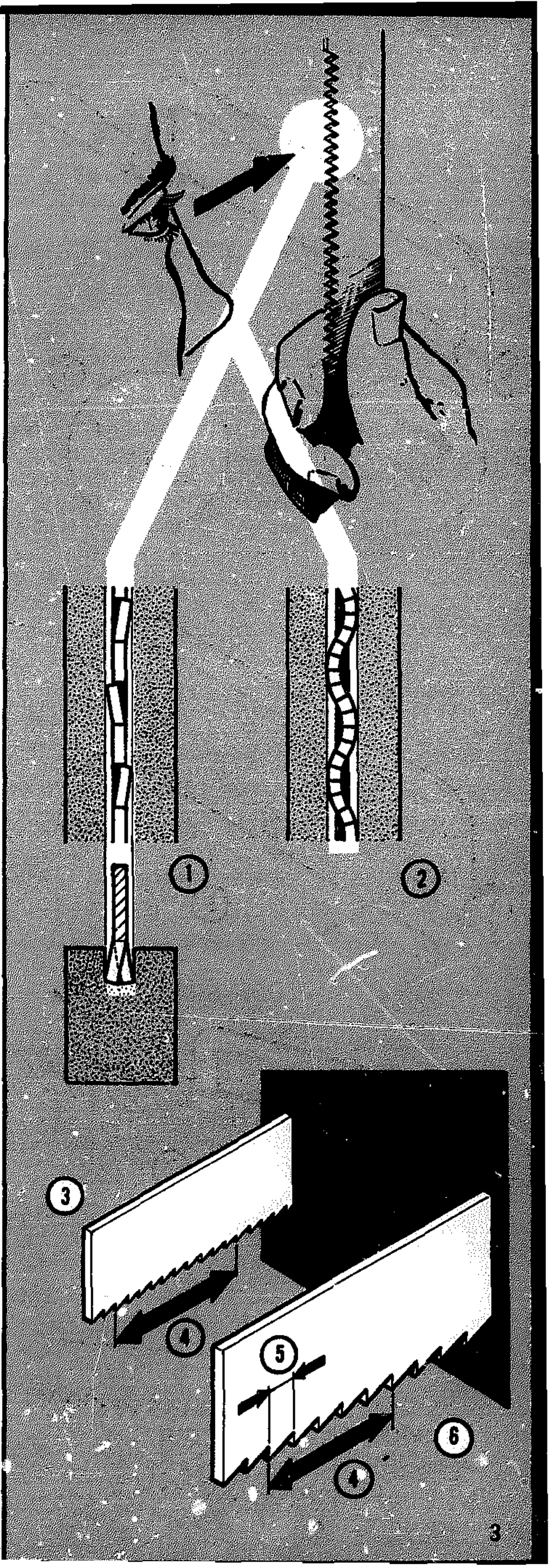
1
Regular set
2
Wave set

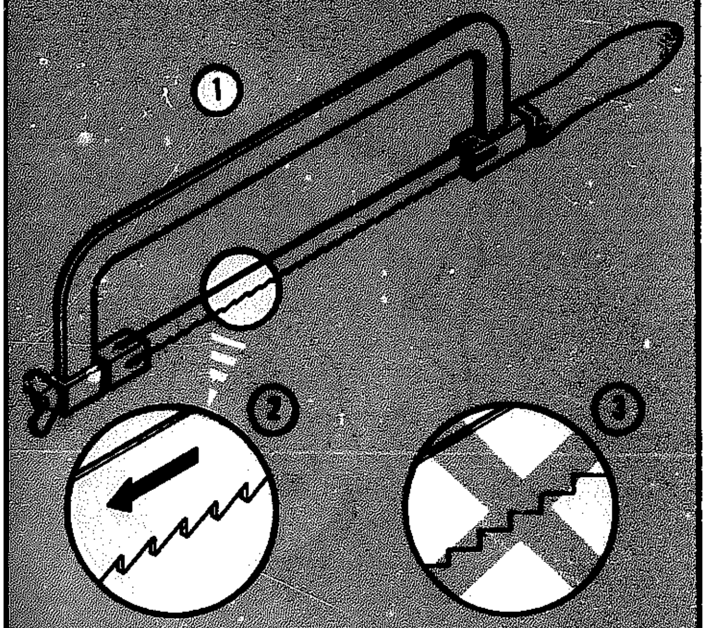
The coarseness or fineness of a saw is indicated by the number of teeth per inch.

The distance between two teeth is called the pitch.

3
Fine-toothed

4
One inch
5
Pitch
6
Coarse-toothed

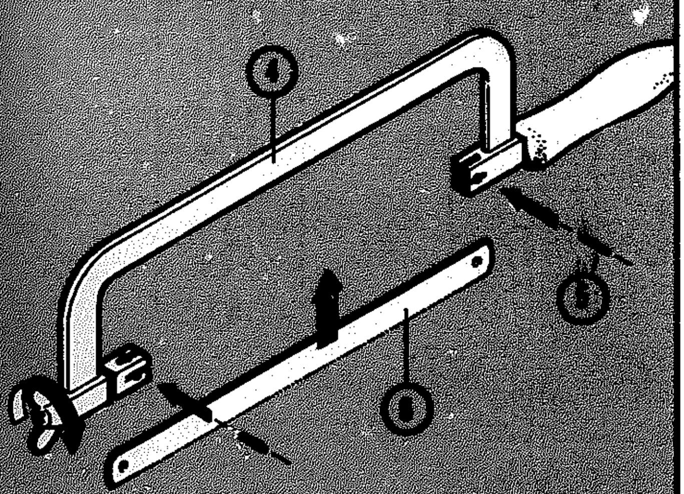




1
Hacksaw

The blade should be fitted in the frame in such a way that the teeth point forward, that is away from the worker.

2
Correct
3
Wrong

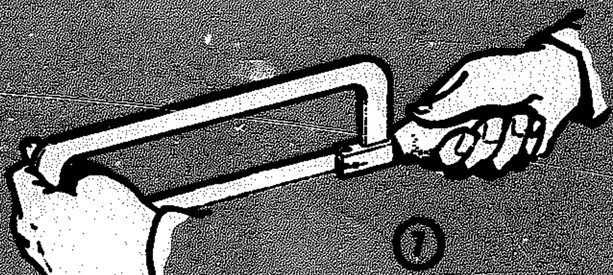


4
Saw frame

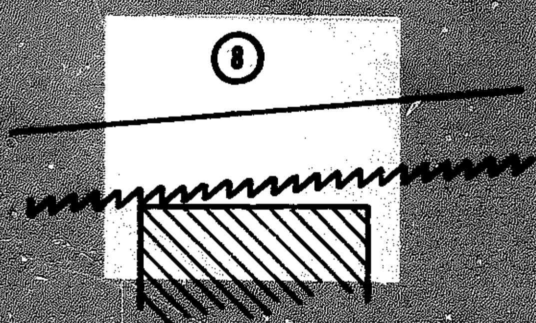
The saw blade is fitted into the frame by means of two pins and is tensioned by means of the wing nut at the end. The saw should not be tensioned too much.

5
Pin

6
Blade



7
Holding the saw



8
Start in this way

When starting to saw, hold saw at a small angle to prevent the teeth from breaking.

A number of special types of saws are shown on this page.

1
Backsaw

2
Adjustable instrument saw

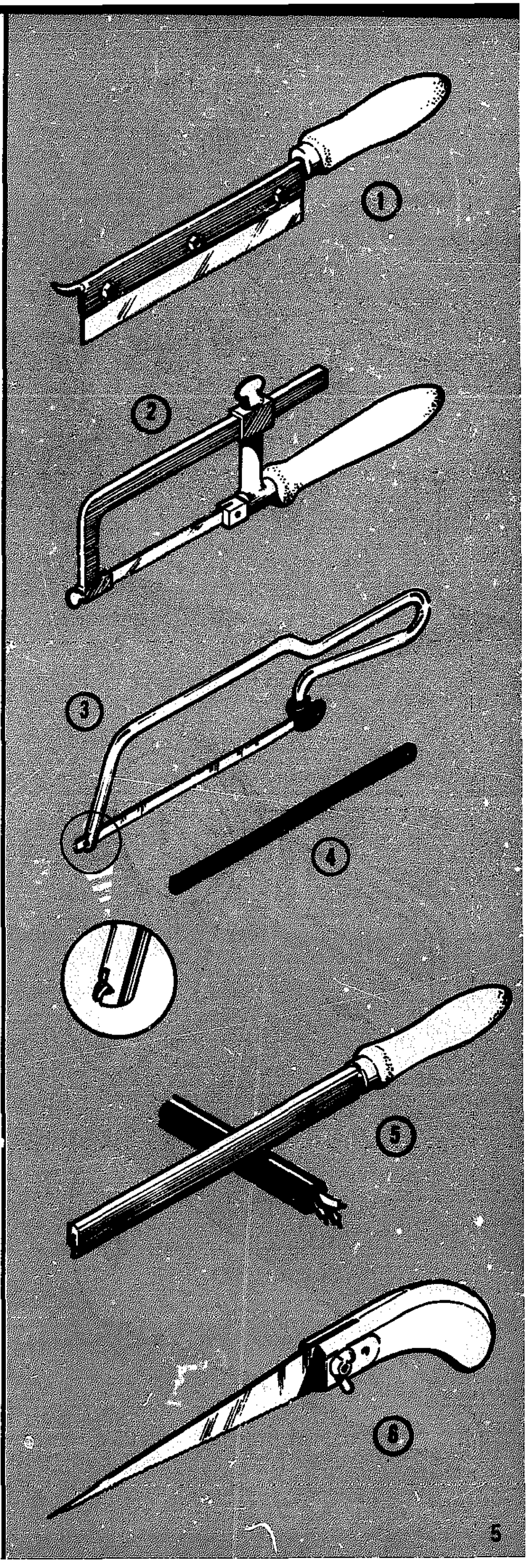
3
Junior saw

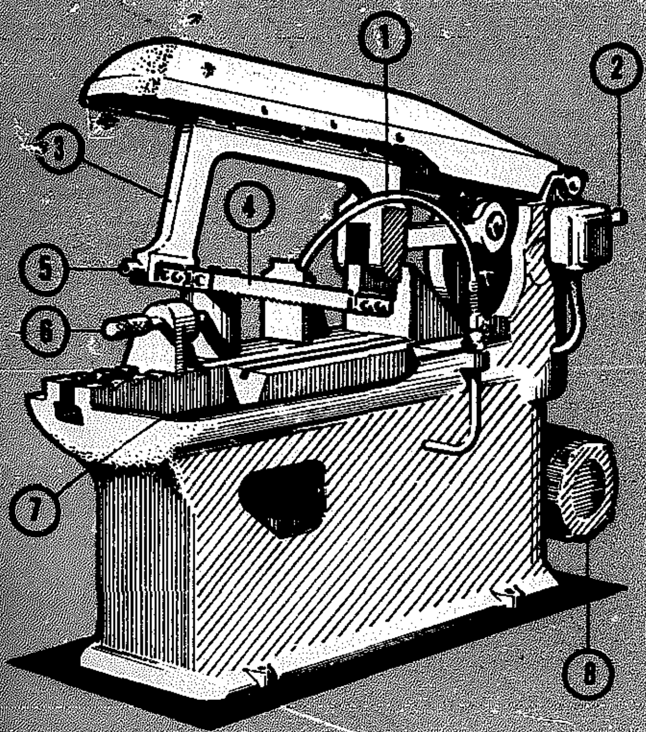
4
Junior saw blade

5
Cable slitting saw

Used for slitting the insulation of electric cables.

6
Compass saw



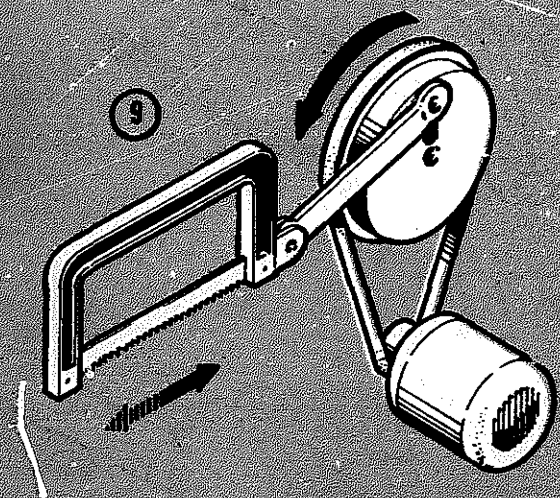


1
Tube for coolant
2
Switch
3
Saw frame
4
Blade
5
Tensioning screw
6
Vice jaw
7
Coolant pan

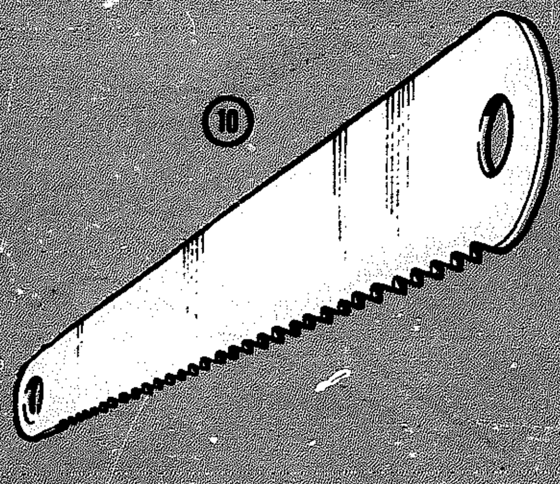
8
Motor

Besides the hand hacksaw there are various mechanical saws. On this page a power hacksaw is shown.

These machines usually have a pulling stroke.
(notice the teeth)



9
Principle of operation

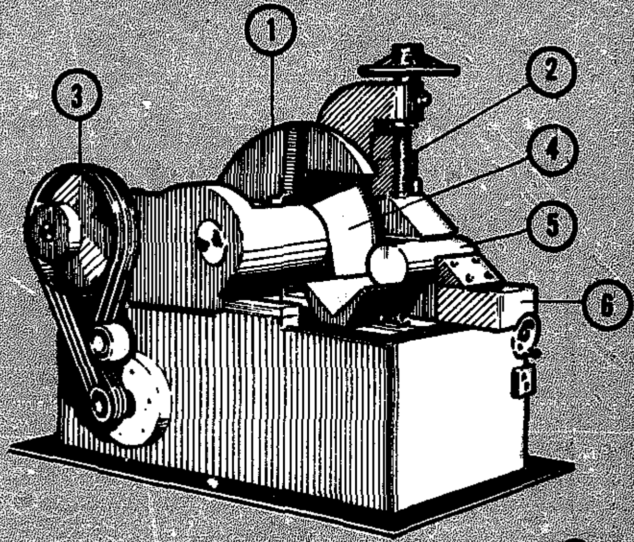


10
Blade

A choice may be made from various types of blades. Some data are given on the last page of this lesson.

Another type of power saw is a circular sawing machine, in which a rapidly turning disc carries the teeth.

1 Guard
2 Clamping device
3 Drive
4 Circular saw blade
5 Work
6 Support



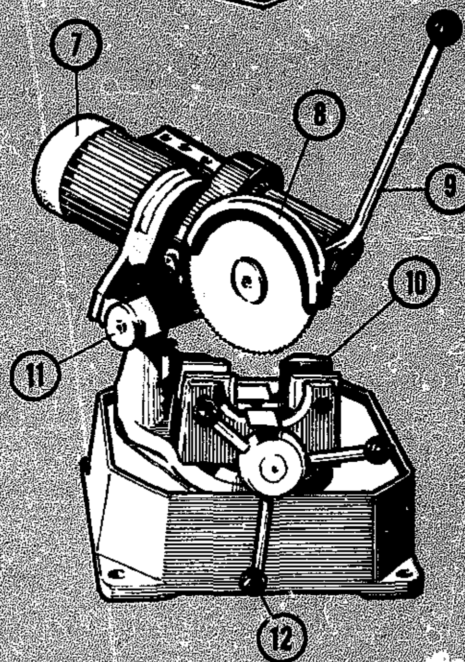
Circular saws may
- have a static blade. The work is pressed against the blade and fed towards it (top figure);
- have a movable blade, the work being stationary (second figure).

7 Motor

8 Guard
9 Feed lever
10 Clamp

11 Pivot

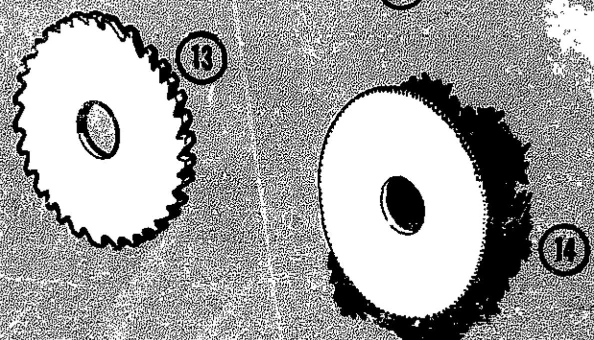
12 Clamping device



Circular saw blades may be coarse-toothed or fine-toothed.

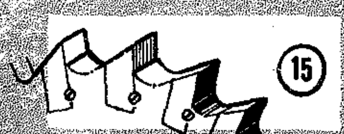
13 Coarse toothed

14 Fine toothed



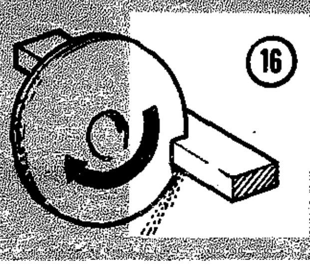
Sometimes the teeth are inserted one by one into the blade.

15 Inserted teeth



Yet another method of sawing is called abrasive cutting. The coarse abrasive wheel rotates at very high speed and softens the work locally. The softened material is slung away by the wheel.

16 Principle of abrasive cutting



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Circular saws may
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Sometimes the teeth are inserted one by one into the blade.

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1
Guard
2
Clamping device
3
Drive
4
Circular saw blade
5
Work
6
Support

7
Motor

8
Guard
9
Feed lever
10
Clamp

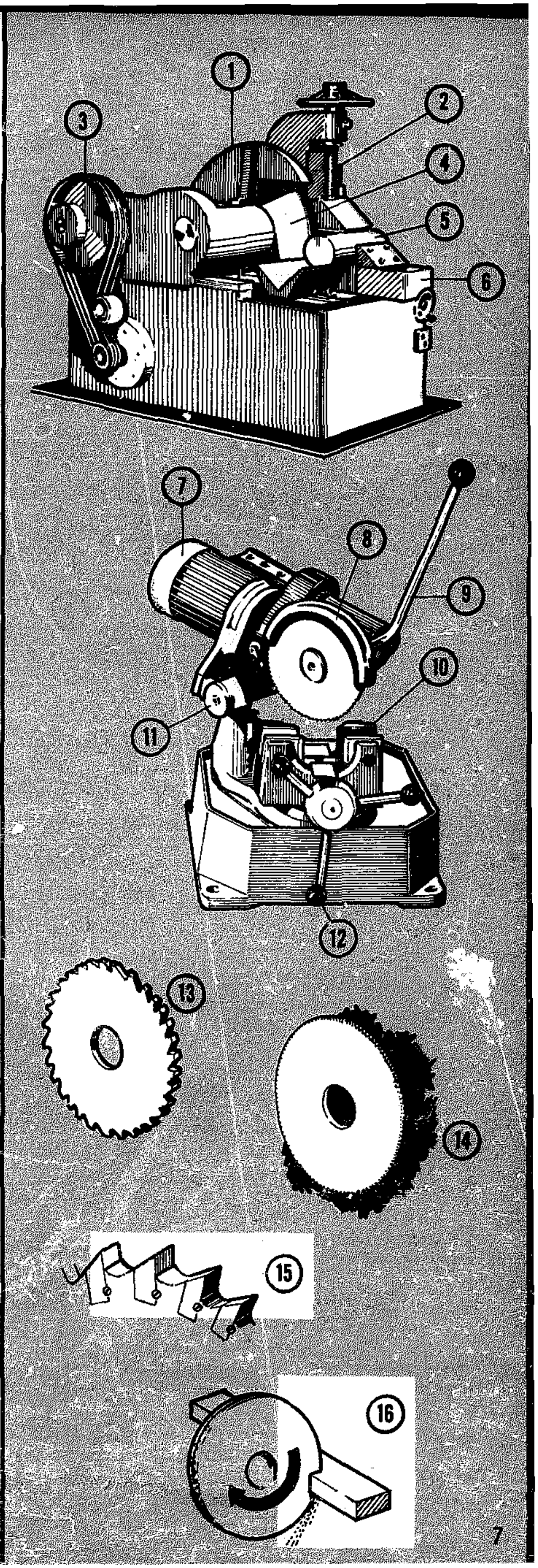
11
Pivot

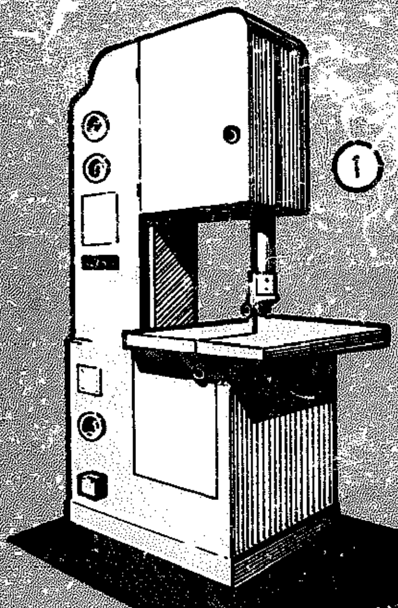
12
Clamping device
13
Coarse toothed

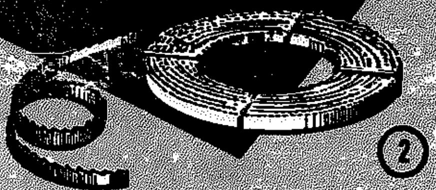
14
Fine toothed

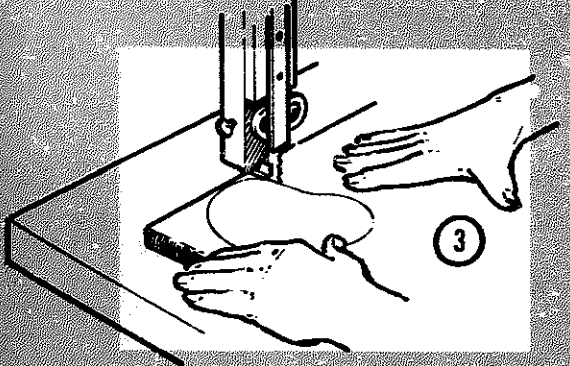
15
Inserted teeth

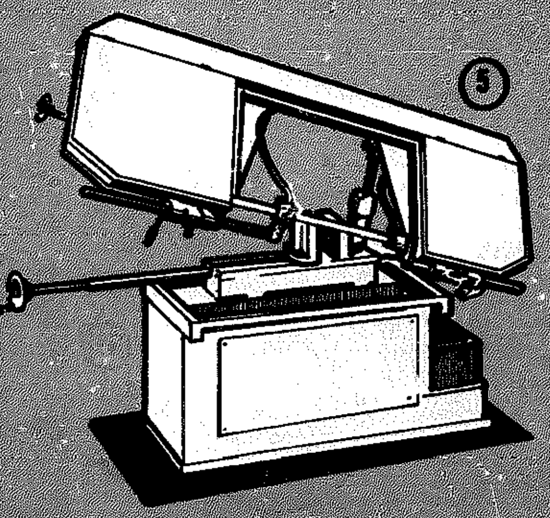
16
Principle of abrasive cutting











1
Band-sawing machine

In a band-sawing machine the saw blade is an endless band. At the top and at the bottom are large wheels. The band is led round these wheels and one wheel transmits the motion.

2
Saw band

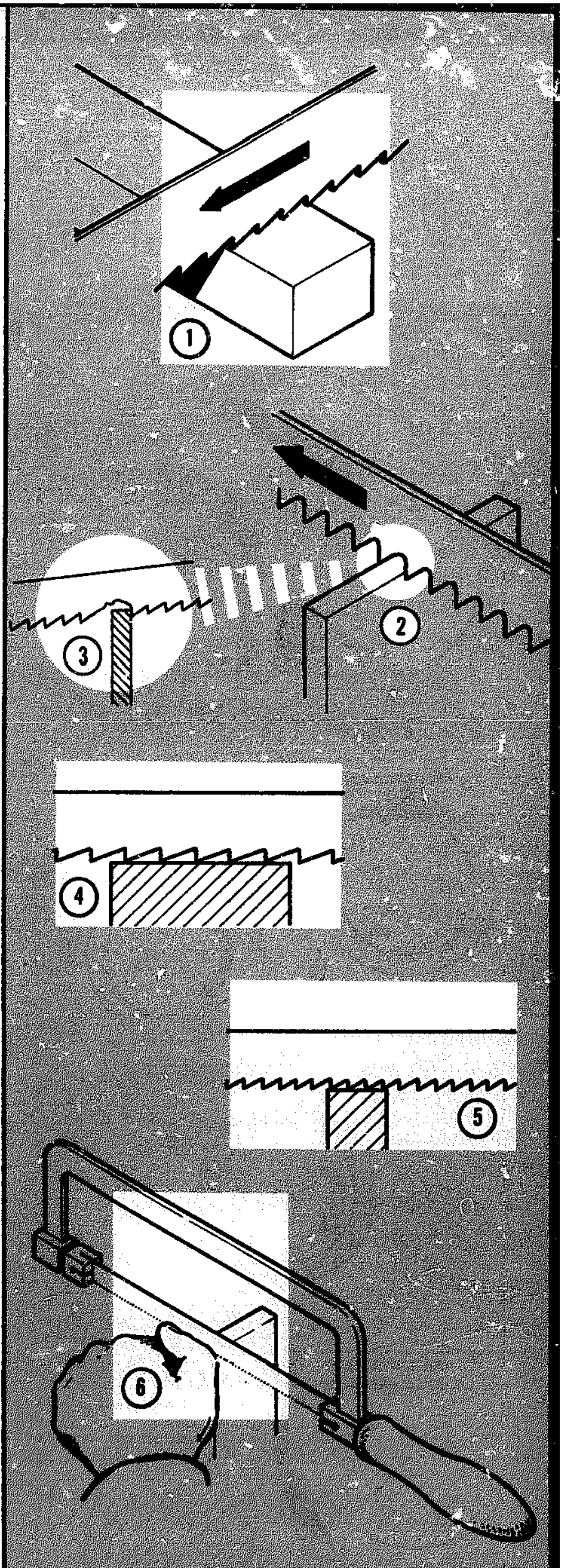
Saw bands are sold in coiled bundles.
The saw band is put on the machine, the right length is cut off and the band is welded together.
When holes are to be sawn the band also requires to be welded.

3
Using the band saw

Rounded shapes can be cut with this type of saw.

4
Workpiece

5
Horizontal band saw



For any material the proper blade should be chosen. At least three teeth should be simultaneously in contact with the material.

1
At least three teeth

2
Wrong !

3
Broken teeth

For thick and soft materials a coarse-toothed saw is used.

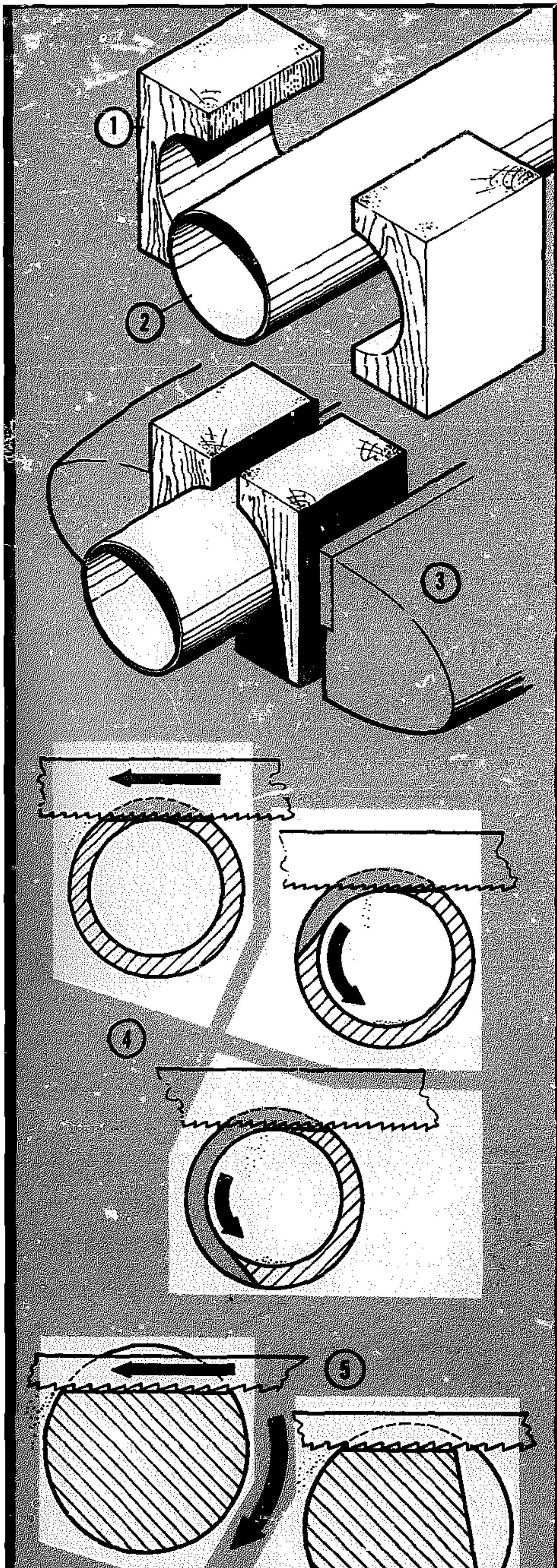
4
Coarse-toothed

For thin and hard materials a fine-toothed saw is used.

5
Fine-toothed

For the first cuts the saw should be guided by the thumb above the teeth.

6
Guiding the saw



1
Wooden packing

For sawing, thin-walled pipe should be clamped in such a way that the pipe is not distorted. So use wooden packings !

2
Thin-walled pipe

3
Clamping

4
Turn pipe regularly

The pipe should also be turned regularly so that several teeth are always cutting at the same time.

5
Thick material

Thick material should first be cut over about a quarter of its thickness.
Then the material should be given a quarter turn before the cutting is continued.

If long cuts have to be made the blade can be set at right angles to the frame.

1
Blade at right angles to the frame

Always clamp the work in such a way that the cut is vertical.

2
Vertical cut

Thin sheet material is clamped on a wooden block.

Keep saw in such a way that at least three teeth are cutting at the same time.

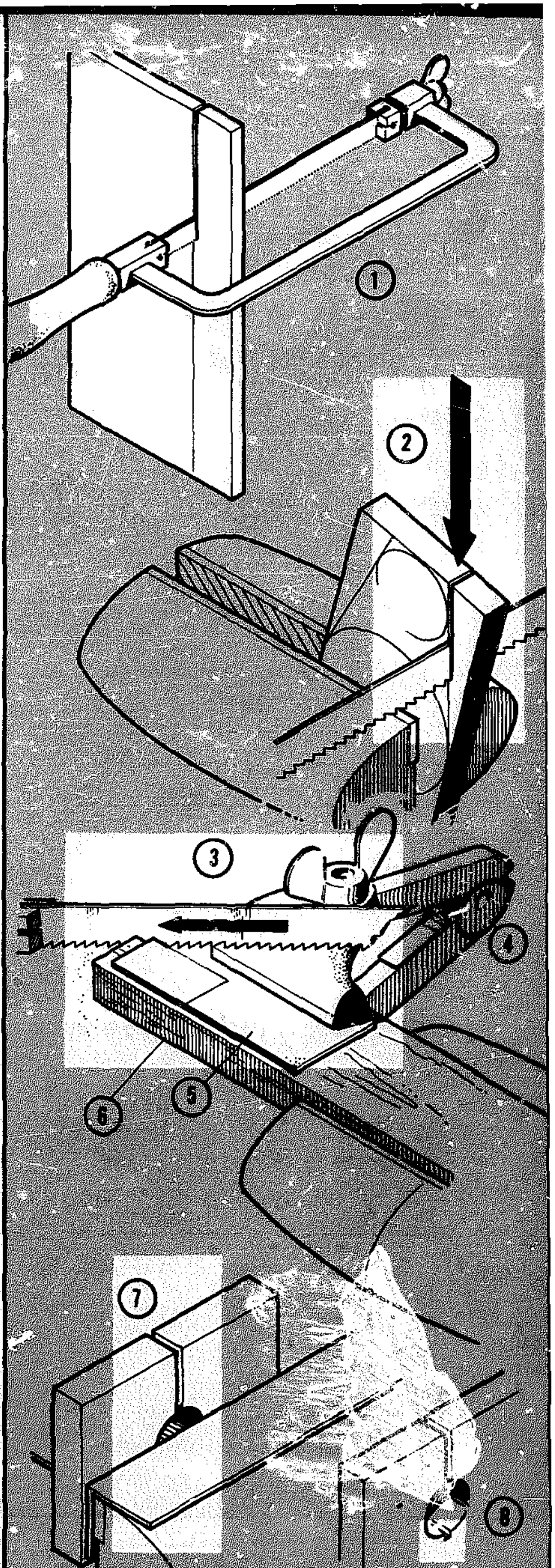
3
Thin material on wood
4
Hand vice

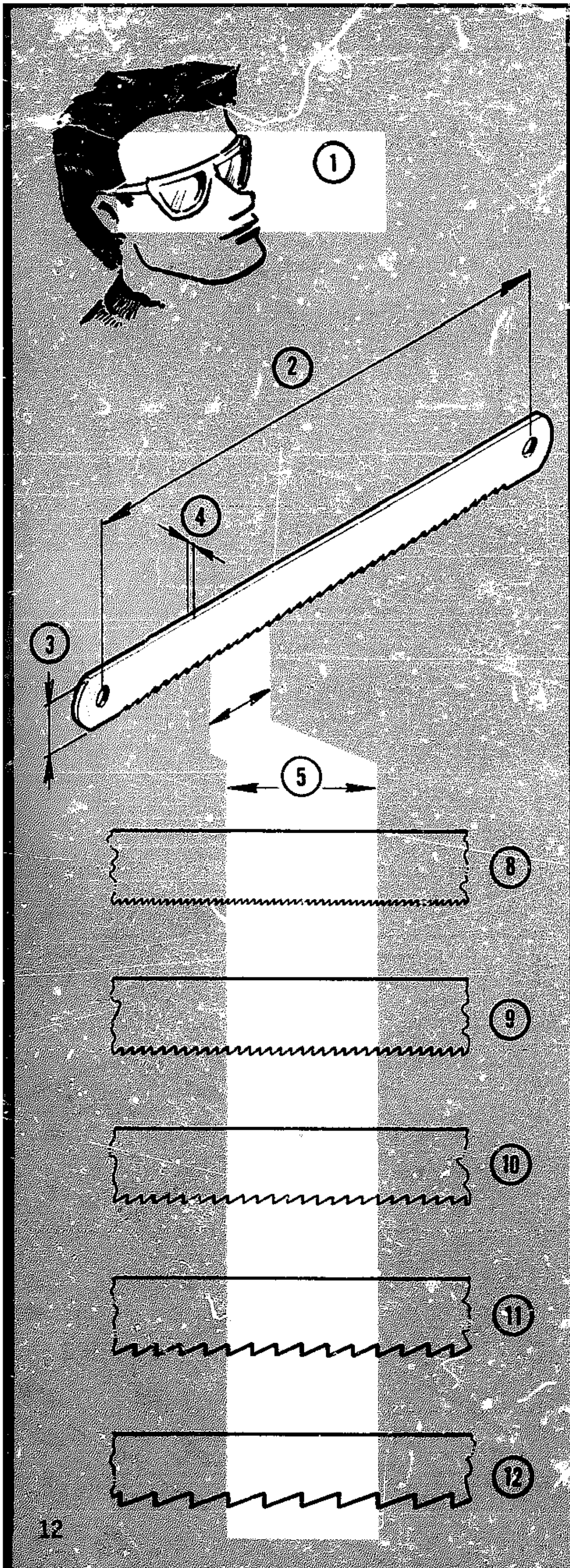
5
Thin sheet metal
6
Wooden block

Clamp work in such a way that the blade cannot touch parts below cut.

7
Cut ends in hole

8
Saw has slipped





1
Goggles

When sawing use goggles.

2
Length in inches

3
Width in inches

4
Thickness in millimetres

5
Number of teeth per inch

6
Number of strokes per minute

7
Materials

8
22 teeth per inch

9
14 teeth per inch

10
10 teeth per inch

11
6 teeth per inch

12
4 teeth per inch

Data for sizes and uses of saw blades are given below:

2	3	4	5
12"	½"	0.65	18-22-24-32
12"	⅝"	0.65	14-18-24-
12"	1"	1.25	10-14
12"	1¼"	1.60	6-10
14"	1"	1.25	10-14
14"	1¼"	1.60	6-10
14"	1½"	2.00	4- 6
16"	1"	1.25	10-14
16"	1¼"	1.60	4- 6-10
17"	1"	1.25	10-14
17"	1¼"	1.60	4- 6-10
18"	1¼"	1.60	6-10
18"	1¼"	2.00	4- 6
18"	1¾"	2.25	4- 6
21"	1½"	1.60	6-10
21"	1½"	2.00	4- 6
21"	1¾"	2.25	4- 6
24"	1¾"	2.25	4- 6

5	6	7
6-10	90-120	Mild steel
6-10	60- 90	Construction steel
		High speed steel
6-10	90	Stainless steel
		Nickle steel
4-10	120-135	Cast iron
4-10	120-135	Brass
4-10	90-135	Bronze
4- 6	120-135	Aluminium
10-14	120	Pipes-light steel sections

ISBN 90 217 1017 X SAWING

INTEMS PICTORIAL SYSTEM

CHIPPING, CHISELLING, GRINDING

Chipping (or chiselling) means cutting away metal by means of a hammer and a chisel.

In figure 1 the man is chipping. He holds a hammer in his right hand and a chisel in his left hand.

1
Chipping

Another way to use hammer and chisel (without cutting away metal chips) is cutting off.

2
Cutting off

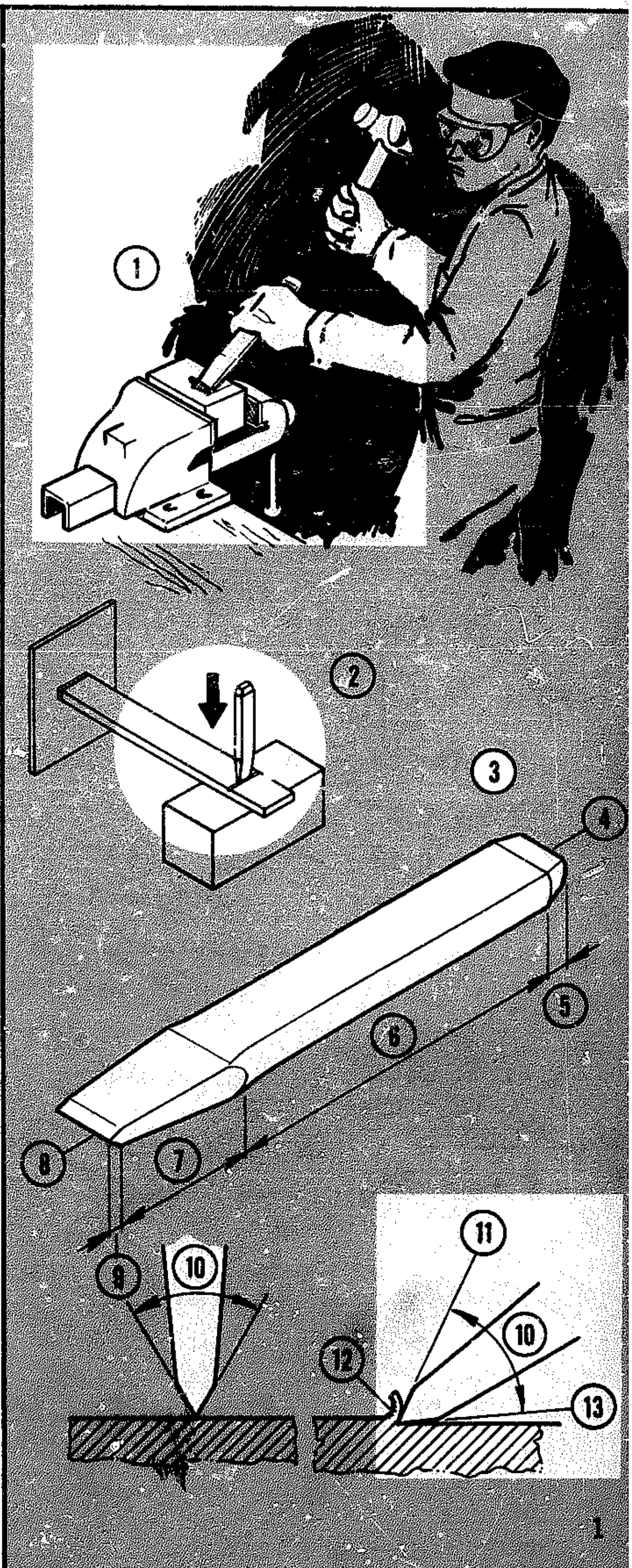
The cold chisel is so named because it is used to cut the metal while it is cold.

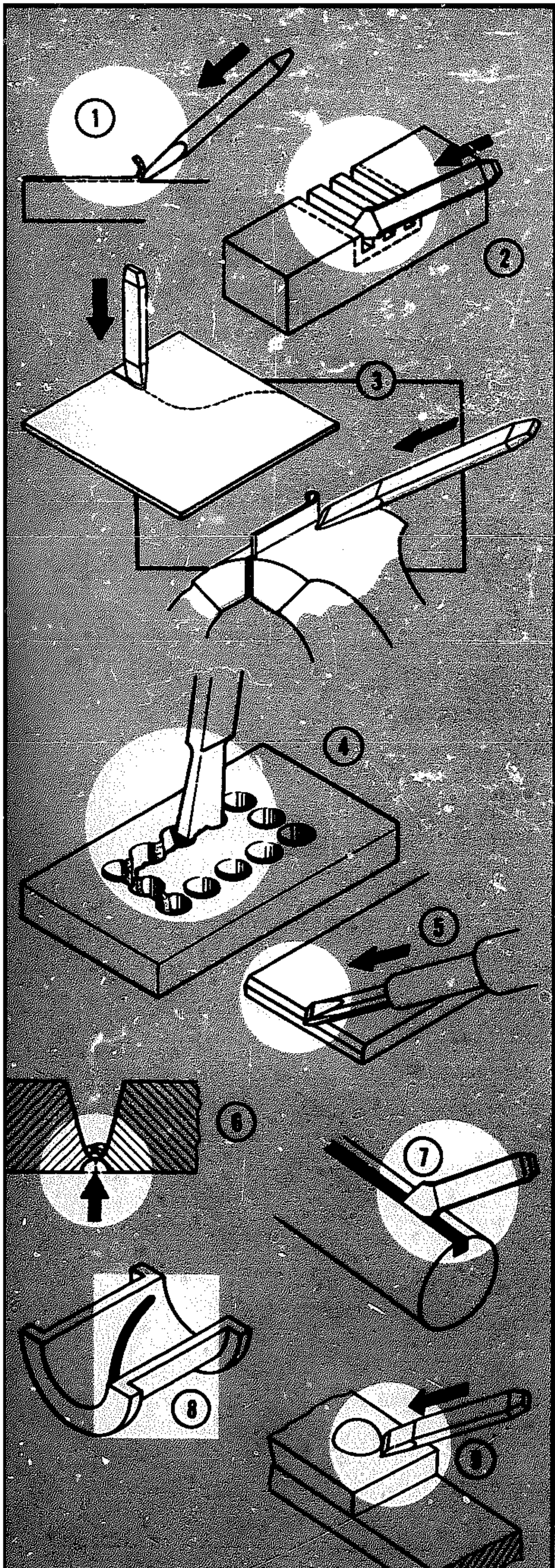
Chisels are made from special chisel steel, forged to shape, hardened and tempered. The cutting end should be hard but not brittle. The other end of the chisel (the head) must be soft.

3
Cold chisel
4
Striking end
5
Head
6
Stock
7
Nose
8
Blade

The cutting edge is ground to the required cutting angle. While being ground the chisel should be cooled with water.

9
Cutting edge
10
Cutting angle
11
Cutting surface
12
Chip
13
Clearance angle





Some USES OF CHISELLING are:

1 Outsides	a. rough shaping of outsides.
2 Insides	b. rough shaping of insides.
3 Sheet metal	c. shaping sheet metal.
4 Waste between holes	d. removing waste between holes.
5 Bevelled or chamfered edges	e. making bevelled edges on material to be welded.
6 Counter	f. making a weld seam with a backing run (or sealing run).
7 Keyway	g. cutting keyways and oil grooves.
8 Oil groove	
9 Rivet head	h. cutting away rivet heads and nuts.

HOLDING THE CHISEL

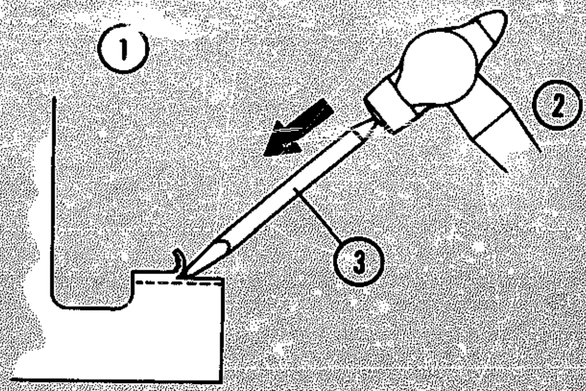
The chisel is held at an angle to the material.

When the head is hit with a hammer the cutting edge penetrates the material.

1
Position of chisel

2
Hamme..

3
Chisel



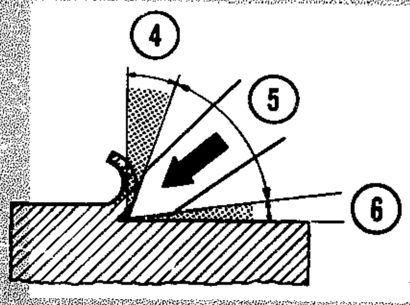
On the cutting end of a chisel we find the following angles

rake,
cutting angle,
clearance angle.

4
Rake

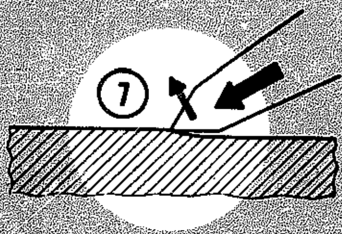
5
Cutting angle

6
Clearance angle



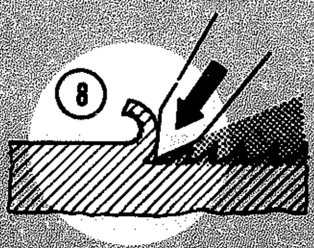
The position of the chisel is very important.
If the clearance angle is very small or even zero, then the chisel slips off.

7
Too flat

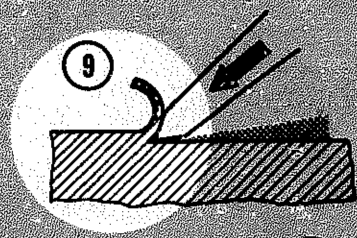


If the clearance angle is too large the chisel digs in too far.

8
Too high

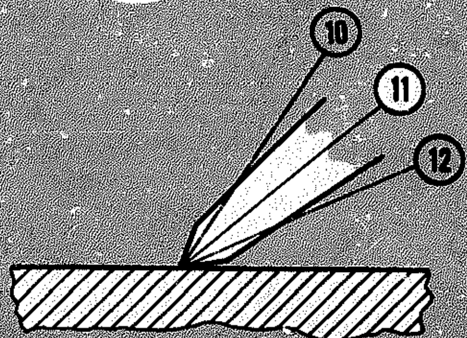


9
Right



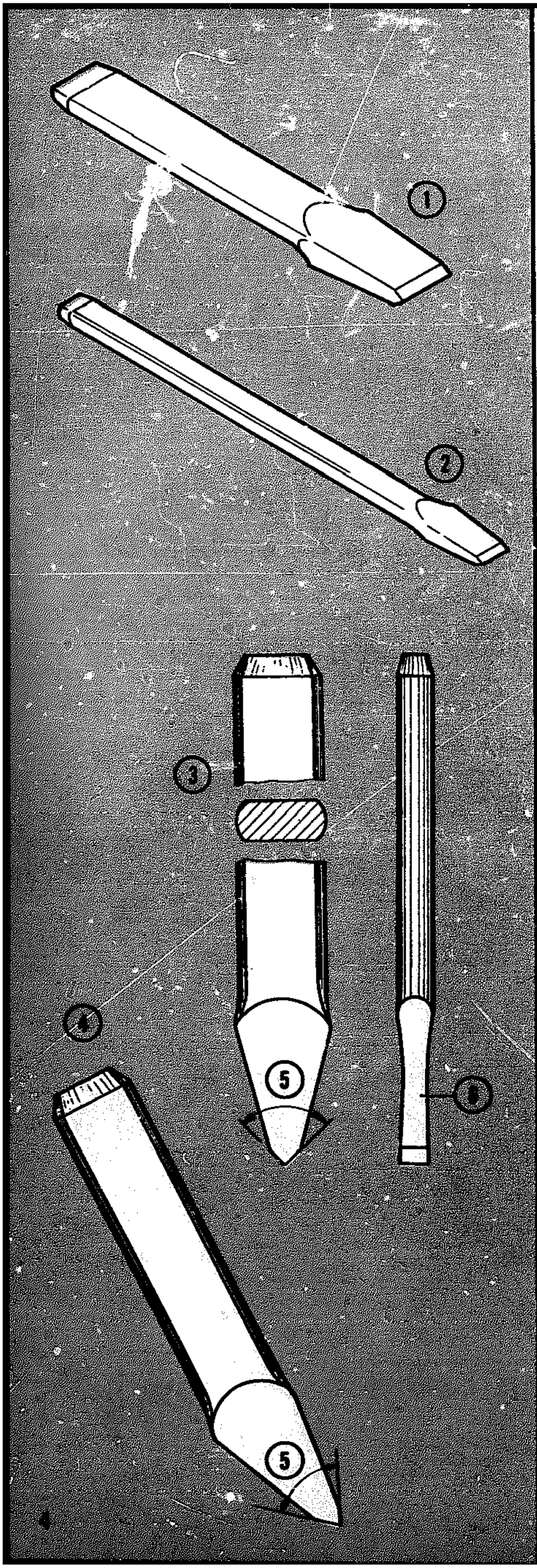
Only the correct position of the chisel gives a good cutting action and a smooth surface.

10
Too high
11
Right
12
Too flat



COLD CHISELS

The chisels most commonly used are shown here.



1
Flat chisel

2
Flat chisel

3 and 4
Cape chisel or cross-cut chisel

5
Cutting angle

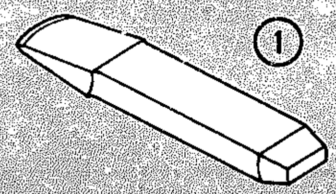
6
Narrowing

a. Flat chisel.
Used for facing, deburring on castings and welds.

b. Cape chisel.
Used for cutting keyways and grooves and slots. The blade narrows behind the cutting edge to prevent the chisel from binding in a slot.

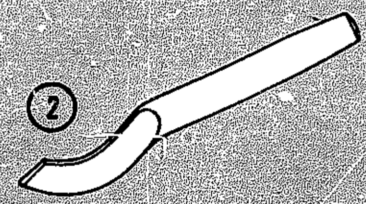
c. Half-round chisel.
Used for cutting curved grooves in sheet steel.

1
Half-round chisel



d. Oil groove chisel.
Used for cutting oil grooves in machine parts.

2
Oil groove chisel

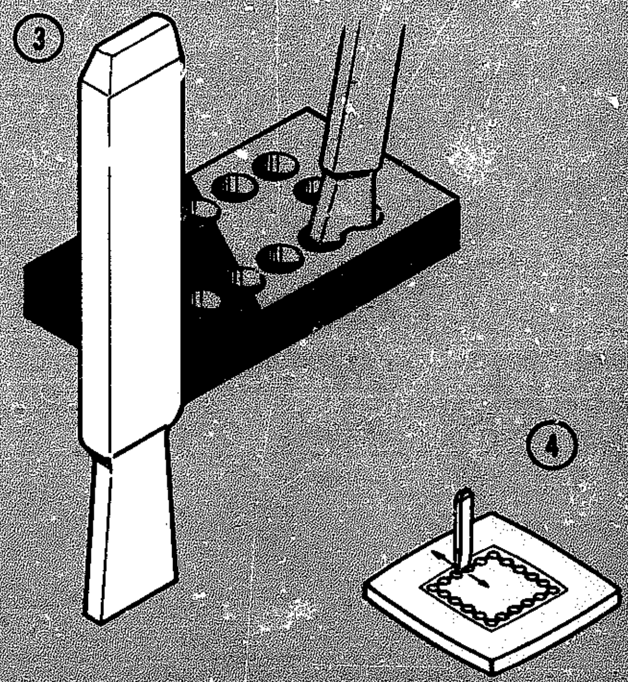


Finally there are punches for removing material between drilled holes when recesses and large holes have to be made.

3
Punching chisel

The work would be distorted if an ordinary chisel would be used for this job.

4
Wrong.
Work is distorted



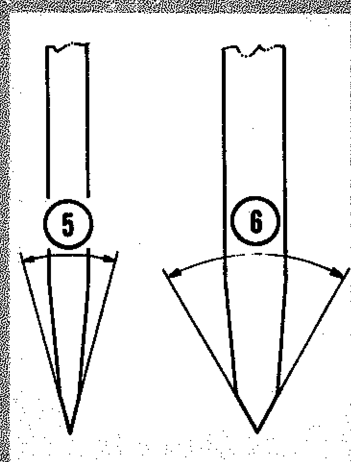
The correct cutting angle depends on the material to be chiselled.

For soft materials such as aluminium a sharp cutting angle (30°) is required.

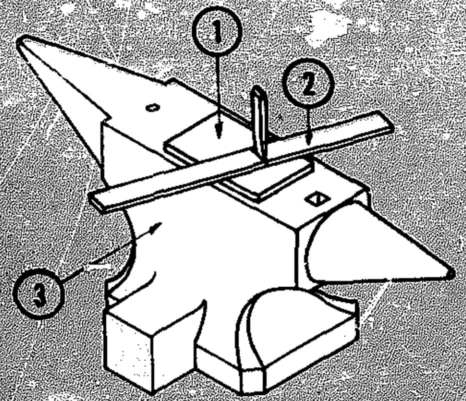
For steel, which is much harder, the cutting angle is about 60°.

5
For soft material
30°

6
For hard material
60°



HOLDING THE WORK.

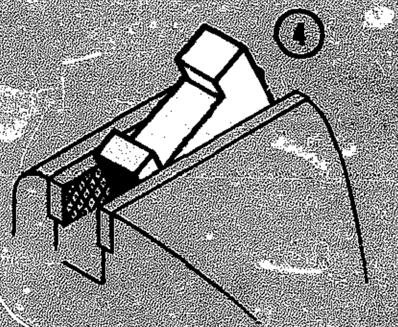


1 Packing block

2 Workpiece

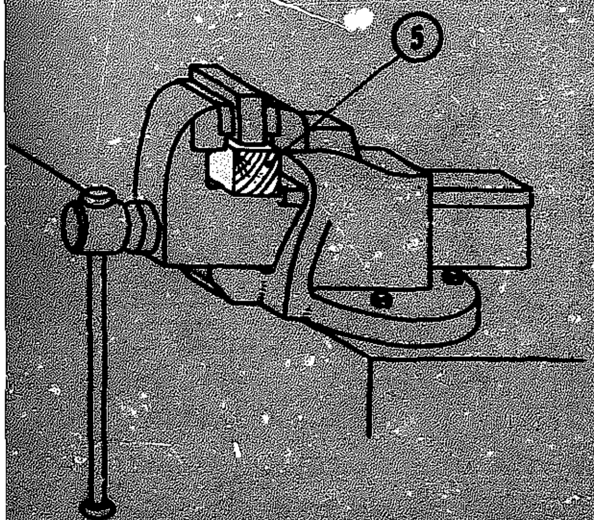
3 Anvil

Material to be cut off is put on a heavy base such as an anvil. To avoid damage a packing block of wrought iron is used.



4 Work slips down

Small jobs are clamped in the vice.



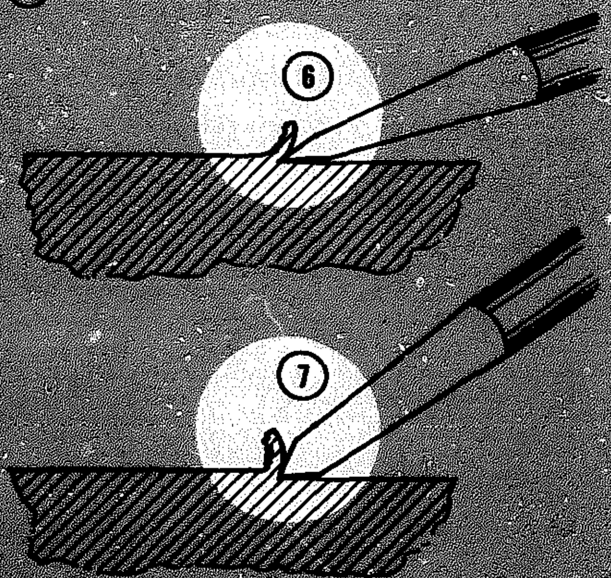
5 Wooden packing block

To prevent the work from slipping down, a wooden packing block is placed underneath.

CHOOSING A CHISEL.

The choice of a chisel depends on the material to be cut.

Therefore



6 Soft material

a sharp cutting angle for soft metal.

7 Hard material

a large cutting angle for hard metals.

1 Light work

For accurate and light work a sharp, slender chisel should be used.

2 Heavy work

For heavy work the chisel should be large.

3 Holding the hammer

The hammer should always be held at the extreme end of the handle.

4 Watch the cutting edge

Always watch the cutting edge when cutting, and not the striking end.
Hold the chisel in such a way that one continuous chip is removed.
The chip should not be too thick - about 1 mm is right.

5 Broad surfaces

Surfaces broader than the cutting edge of the chisel are chiselled as shown in fig. 5.
Adapt your speed and force in such a way that you can go on chiselling for a long time.

CUTTING SHEET METAL

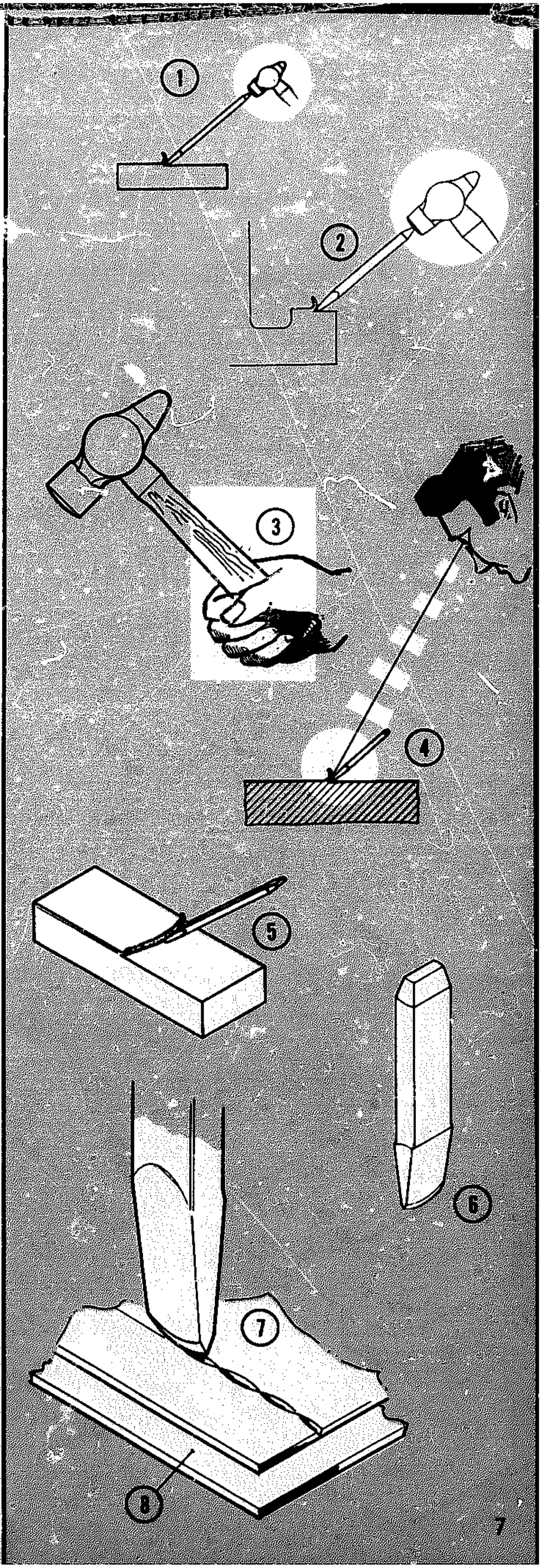
6 Curved cutting edge

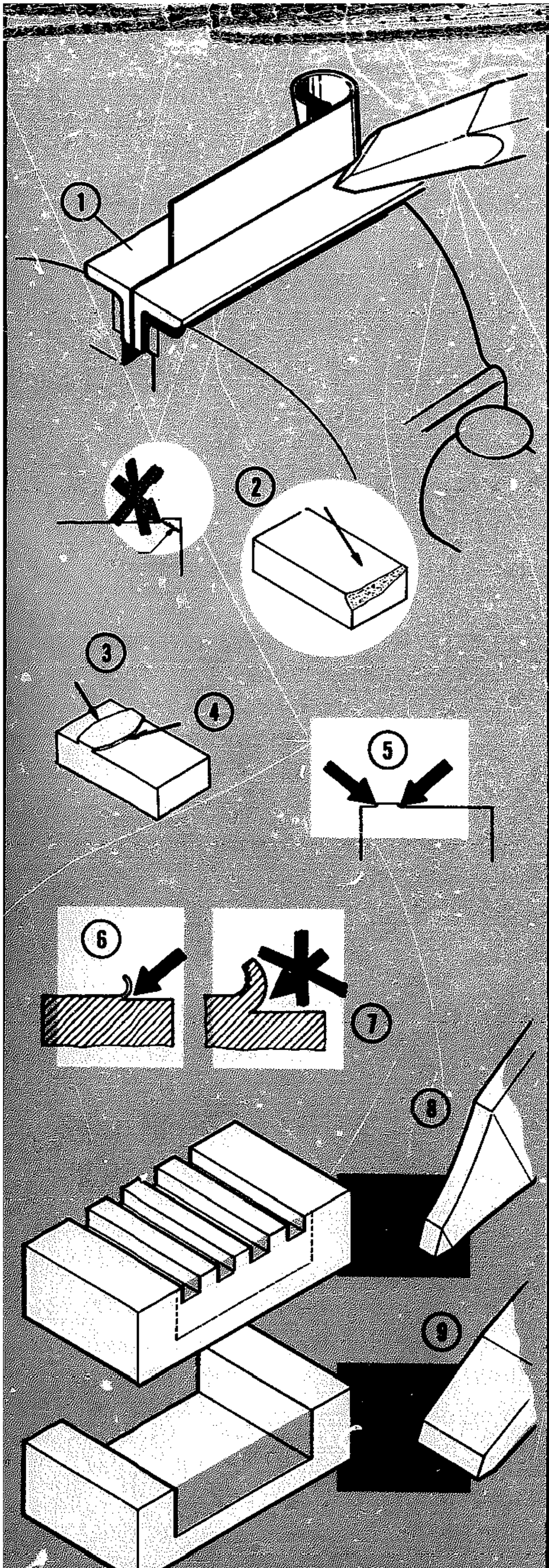
7 Cutting sheet metal

Use a chisel with curved cutting edge. This is the only one to give a straight line. If necessary a continuous shallow groove is first cut and later cut through.

8 Packing block

Always use a packing block under the workpiece.





1 Angle sections

When chiselling in the vice the cutting edge rests on it. Clamp the work between angle sections to avoid damaging the jaws of the vice.

CHIPPING

2 Fracture

Brittle material should be cut in such a way that the edges cannot break.

Therefore chipping should always be done from two sides.

3 First cut

First a cut should be given from the edge.

4 Definite cut

5 Correct

6 Good chip

Cut evenly with the right thickness of chip.

7 WRONG. Chip too thick

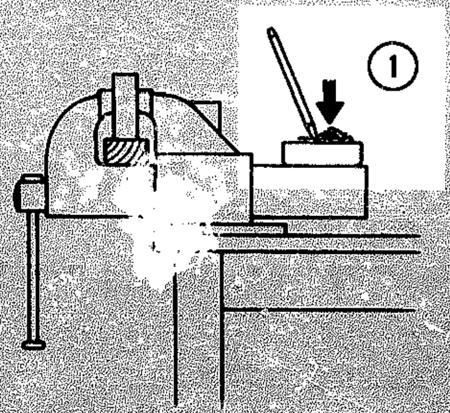
8 Grooving chisel

The grooving chisel is a cross-cut chisel.

9 Flat chisel

If much of the stock has to be removed, cut first channels with the cross-cut chisel.

Now and then press cutting edge in wad of waste cotton soaked in oil.



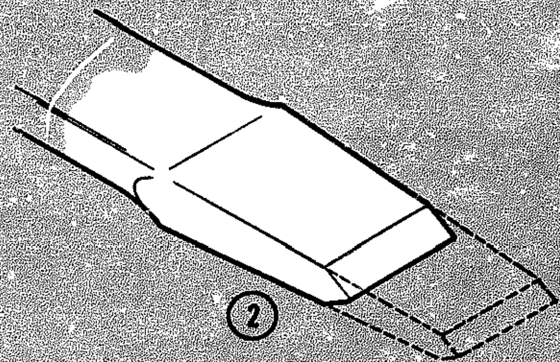
1
Oil soaked cotton

SHARPENING A CHISEL

When grinding a chisel see to it that the least possible amount of steel is ground away.

The cutting edge must not grow too hot.
Therefore the chisel should be cooled during grinding.
If the cutting edge has turned blue the chisel should be hardened again.

Hammer out if blade is too thick.

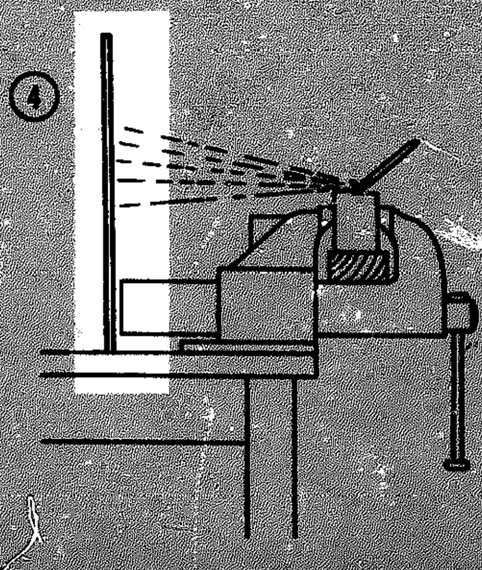


2
Blade too thick

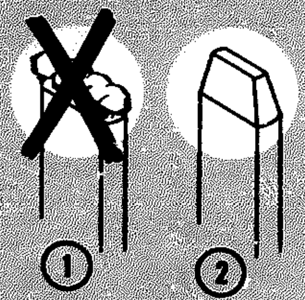
SAFETY

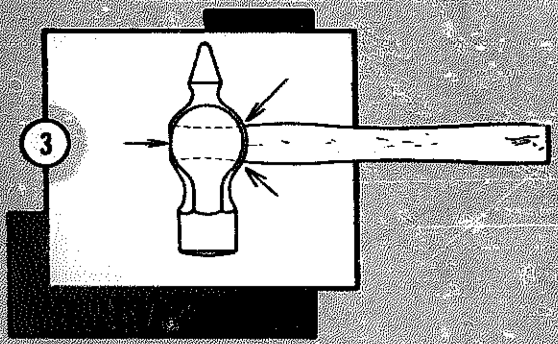
3
Goggles

The slogan for chipping is: SAFETY FIRST.
Therefore always wear goggles and place a chip guard in front of the work to catch the chips.



4
Chip guard





1 Mushroom head

At regular intervals remove burrs from head, so that no "mushroom head" is formed.

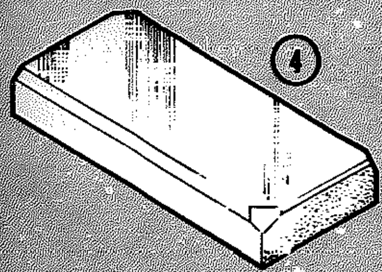
2 Correct head

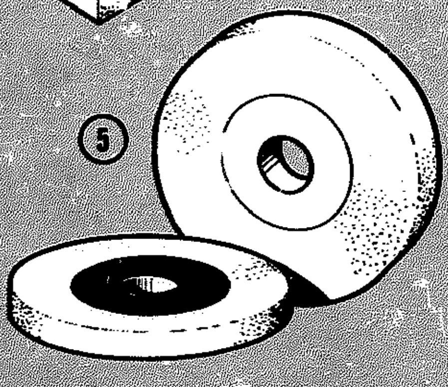
Keep face of hammer clean to prevent it from glancing off the work. Check that handle of hammer fits immovably in head.

3 Rigidly attached hammer

GRINDING TOOLS

Cutting tools like chisels or drills grow dull by use. They have to be resharpened regularly. To this end grindstones and oilstones are used.



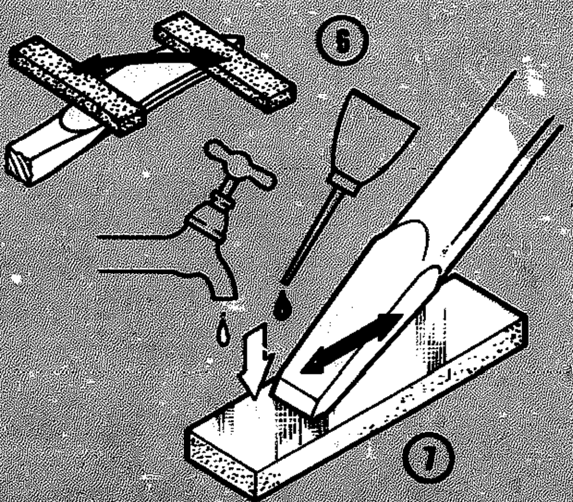


4 Oilstone

Oilstones are used to give all sorts of cutting tools an extremely accurate and smooth cutting edge.
To this end a natural siliceous stone is used. Oilstones should be handled with care and kept in a wooden box.

5 Grinding wheel

Instead of oilstones, grinding wheels may be used. These wheels are made artificially and consist mainly of abrasive grains bonded together.



6 and 7 Sharpening with oil-stones

During sharpening oil or water is applied.
Either the stone is moved across the tool or the tool across the stone.

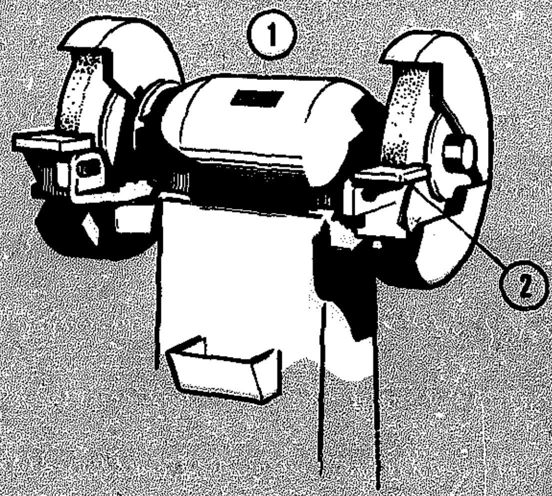
GRINDING

Grinding wheels are mounted on a grinder, or grinding machine.

1
Grinder

Most grinders have a tool rest, which supports the tool to be ground.

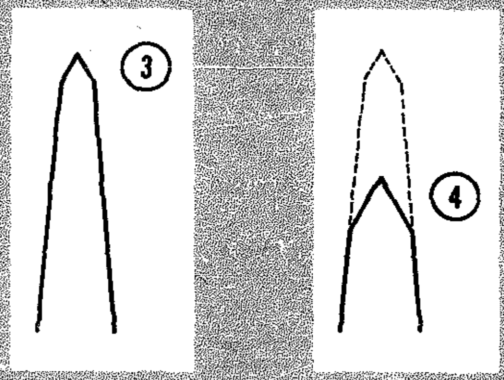
2
Tool rest



Chisels are ground on a grinding wheel. When a chisel has been reground many times, the cutting end becomes too thick to be useful. To reshape it, it should be hammered out.

3
Good chisel

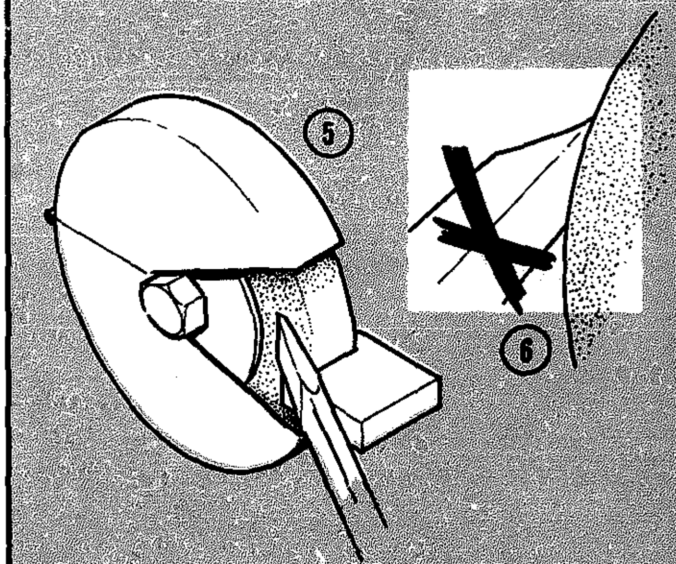
4
Useless chisel



Chisels with a straight cutting edge are usually ground on the side of the grinding wheel. This is better than using the face because of the danger of grinding a hollow cutting edge.

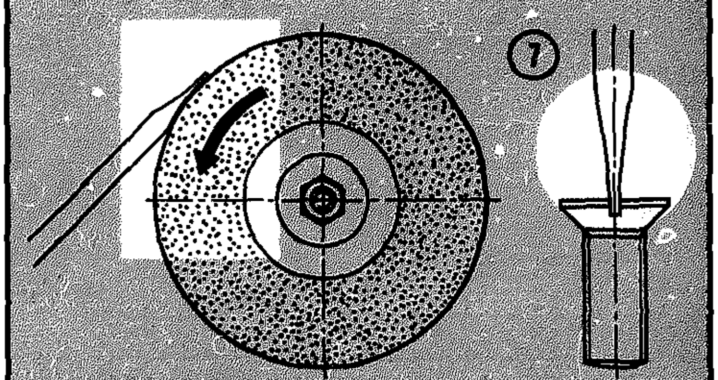
5
Grinding a chisel with straight cutting edge

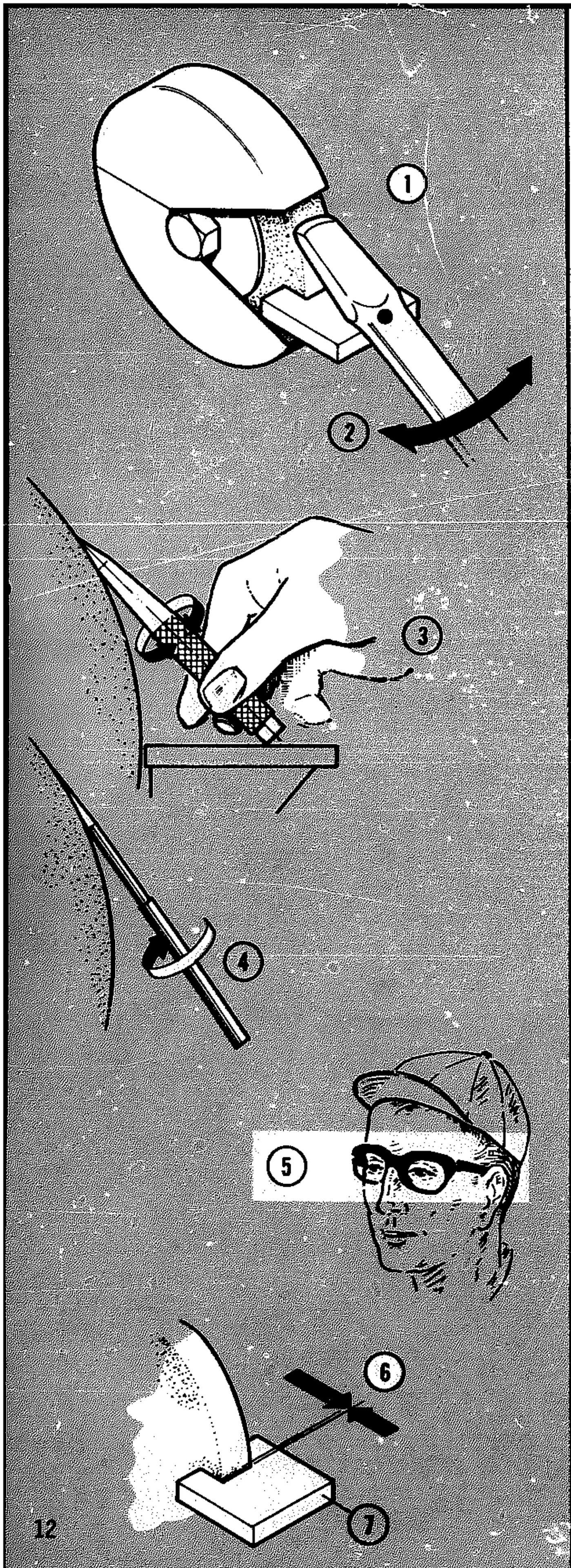
6
WRONG: Hollow point



For grinding screwdrivers the face can be used.

7
Grinding a screwdriver





1 Grinding a curved cutting edge	In figure 1 the way of grinding curved edges on half-round chisels is shown.
2 Movement on the hand	
3 Grinding a punch	How centre punches are ground is shown in fig. 3. The point of the punch should be on the centre line of the grinding wheel. Grinding is done by hand. The punch is turned slowly but continuously between forefinger and thumb.
4 Grinding a scriber	Scribers should be quite sharp to do their job well. Grinding is done in the same way as for centre punches but more care is needed because scribers are so thin. Light sharpening can also be done on the oilstone.
	SAFETY
5 Goggles	Always wear goggles when grinding.
6 Gap	
7 Tool rest	Place the tool rest as close to the grinding wheel as possible and use it.

ISBN 90 217 1018 8 CHIPPING, CHISELLING, GRINDING

INTEMS PICTORIAL SYSTEM

WELDING

Welding is joining two metals by melting them locally, together with filler metal.

There are two main groups of methods:

a. GAS WELDING, where the heat is produced by a flame through a blow pipe, using oxygen and some other gas as fuel. The other gas is normally acetylene.

b. ARC WELDING, where the heat is produced by striking an electric arc between the metals to be welded and an electrode.

In gas welding the filler metal is applied as wire or a rod.

In arc welding the electrode itself is melted away as filler metal.

1 Welded joint

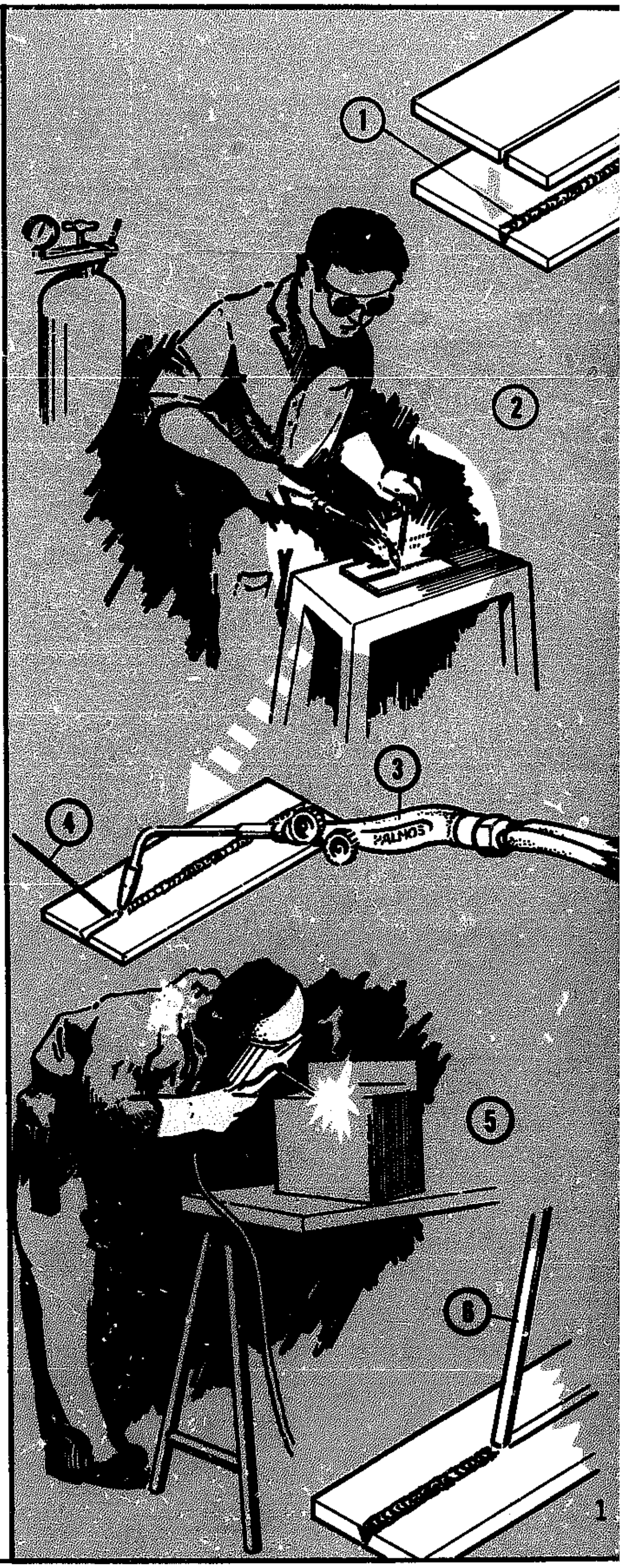
2 Gas welding

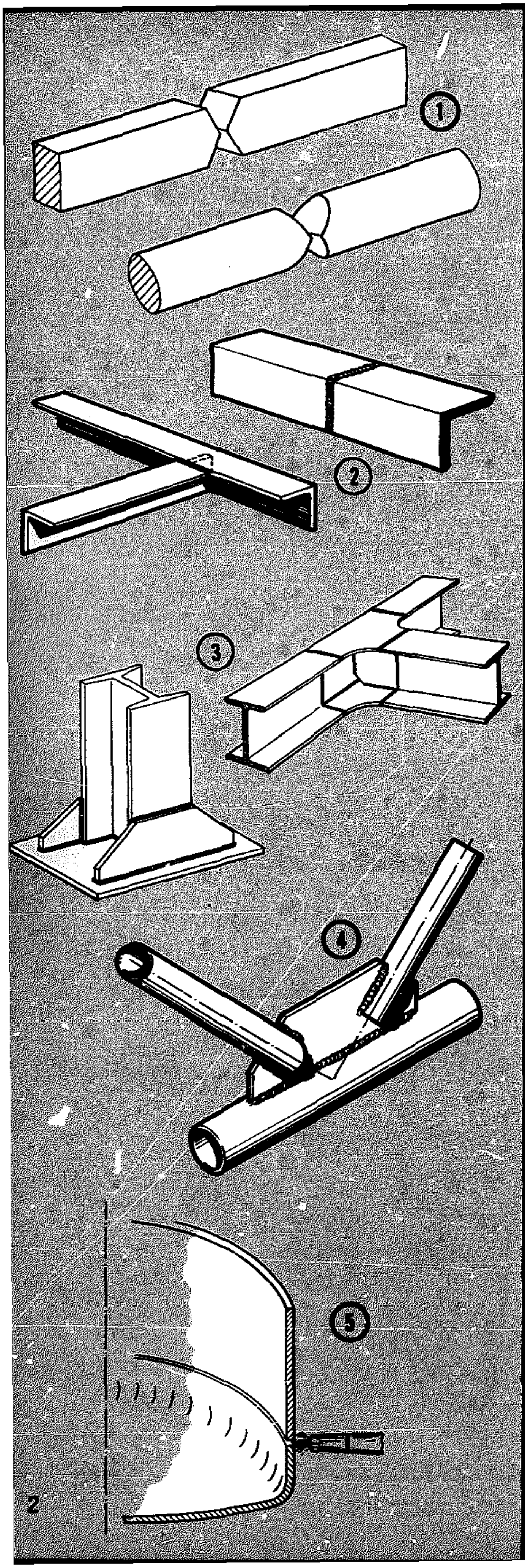
3 Blow pipe (welding torch)

4 Filler metal

5 Arc welding

6 Electrode





1
Bars

Among other applications of welding are the joining of:
- round or square sectioned bars,
- angles and sections,
- pipes,
- sheets.

These are only very few of the possibilities.

2
Angles and sections

In principal gas- and arc welding can mostly be used with the same result.
The following division in the use can be made:

ARC WELDING

is suitable for a wide field of applications e.g.
- steel plate
- steel structures
- piping (wall thickness 5 mm and more)
- aluminium (expensive method in large factories)
- other metals (as stainless steel, nickel)

3
Sections and sheets

4
Pipes

GAS WELDING

is suitable for welding of
- thin steel sheet
- complicated piping
- aluminium (cheap method in small workshop)
- some other metals (stainless steel, copper (brasses especially), nickel (restricted)).

5
Plates and sheets

Gas welding is used when no electric energy is available.

For arc welding the electrode is fitted into an electrode holder which is electrically connected by a cable to one of the two terminals of the welding set. The workpiece is electrically connected to the other terminal of the welding set by means of an earth (ground) clamp and earth (ground) lead.
When the electrode is brought into contact with the workpiece the electrical circuit is closed.
By drawing the electrode away from the workpiece a very hot arc is formed which melts the metal.

1
Electrode holder
2
Electrode

3
Connection to workpiece by means of ground clamp
4
Slag

The electrode has a coating, which melts into a slag (4). This slag forms a layer on the molten metal. This layer protects the metal against oxidation.

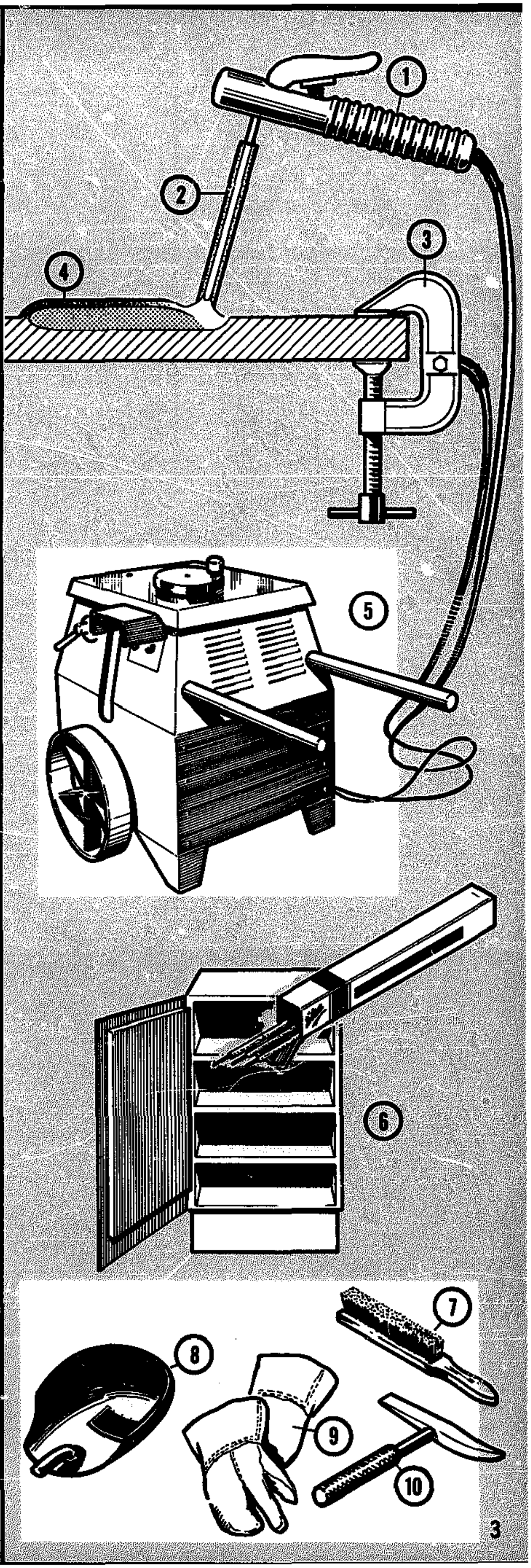
5
Arc welding transformer (a.c.)

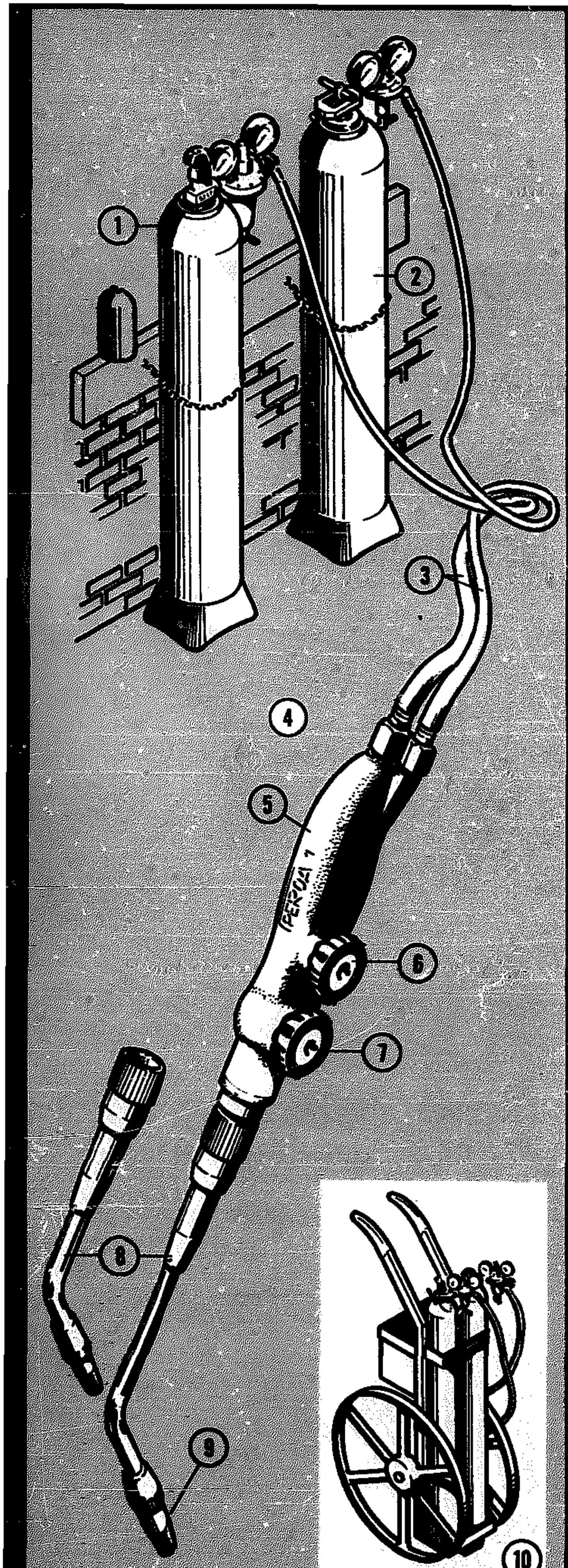
As there are many types of electrodes which should be kept apart and always dry, an electrode cabinet is very useful.

6
Electrode cabinet

The electric arc radiates ultra-violet rays which can damage the eyes and hands. Therefore always use a face shield and gloves.
When gas welding wear welding goggles. Leather gloves and apron are worn as a protection against rays, sparks and spatter of molten metal.
Steel brush and chipping hammer are tools for cleaning welds.

7
Steel wire brush
8
Face shield
9
Gloves
10
Chipping hammer





	For gas welding the flame is usually produced by burning a mixture of acetylene and oxygen.
1 Oxygen cylinder 2 Acetylene cylinder	These gases are kept under pressure in steel cylinders. On the top of the cylinders are regulators to reduce the pressure of the gases to a suitable working pressure in the blow pipe.
3 Hoses to the torch	From the regulators the gases are fed to the blow pipe or torch through hoses.
4 Blow pipe or welding torch	In the torch the gases come together and the mixture is lighted at the tip or nozzle.
5 Handle	For good work it is extremely important that the flame is correctly adjusted.
6 Acetylene valve 7 Oxygen valve	This adjusting is done by means of the two valves on the torch. Usually the oxygen valve is nearest to the nozzle.
8 Blow pipe head	The blow pipe head is interchangeable, because for different plate thicknesses different heads are necessary.
9 Nozzle	Dependent on the work, various nozzles are used.
10 Trolley	For easy transport the cylinders may be placed on a special trolley.

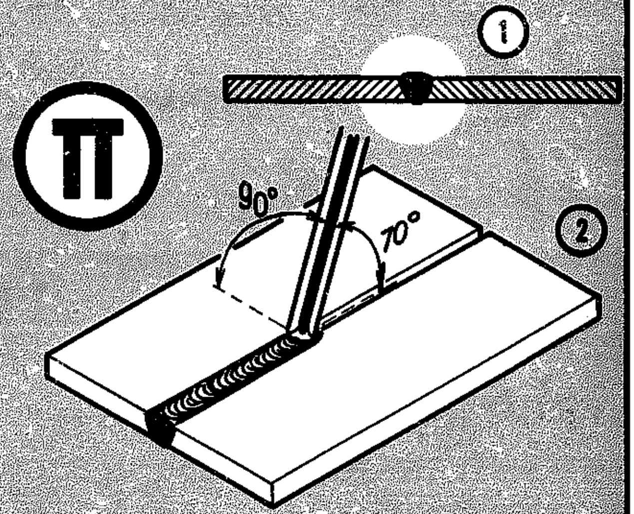
Depending on the thickness of the material various types of joints are made. The principal types are shown on this page and the page overleaf.
Some data are given here:

SQUARE BUTT WELD
(welded one side)

plate thickness max. 3 mm
gap ½ plate thickness
position of electrode see fig. 2.

1
Square butt weld (welded one side)

2
Position of electrode



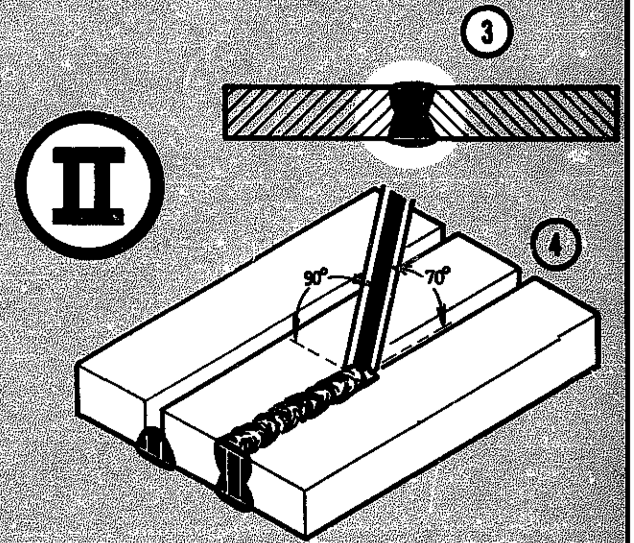
SQUARE BUTT WELD
(welded both sides)

plate thickness 3-6 mm
gap ½ plate thickness

The weld is completed in two runs. After the first one the workpiece is turned over, the root of the bead gouged and cleaned before the second run is made.

3
Square butt weld (welded both sides)

4
Position of electrode



SINGLE-V BUTT WELD

plate thickness 5-16 mm
included angle 60^{0}
root gap ca. 3 mm

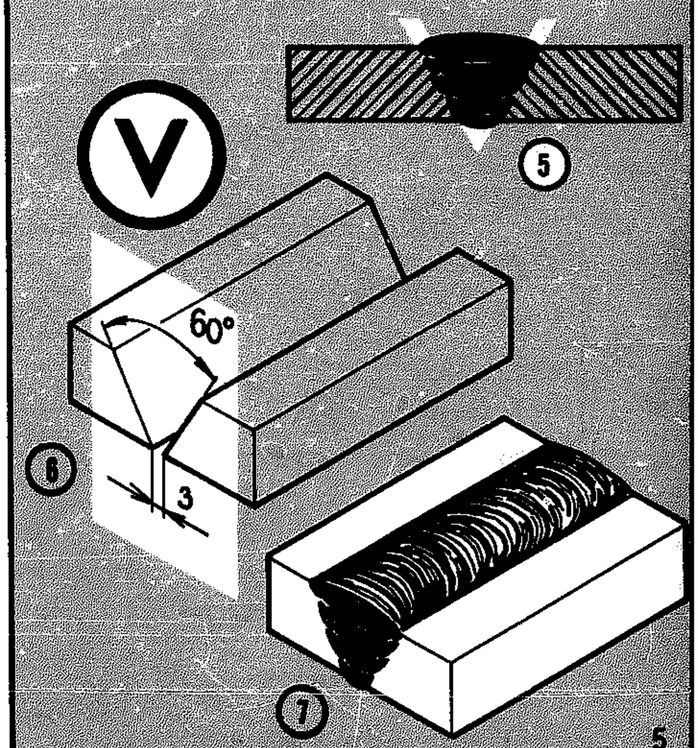
The V-joint is completed in several runs.
Before each following run the previous one must be cleaned first by removing the slag.

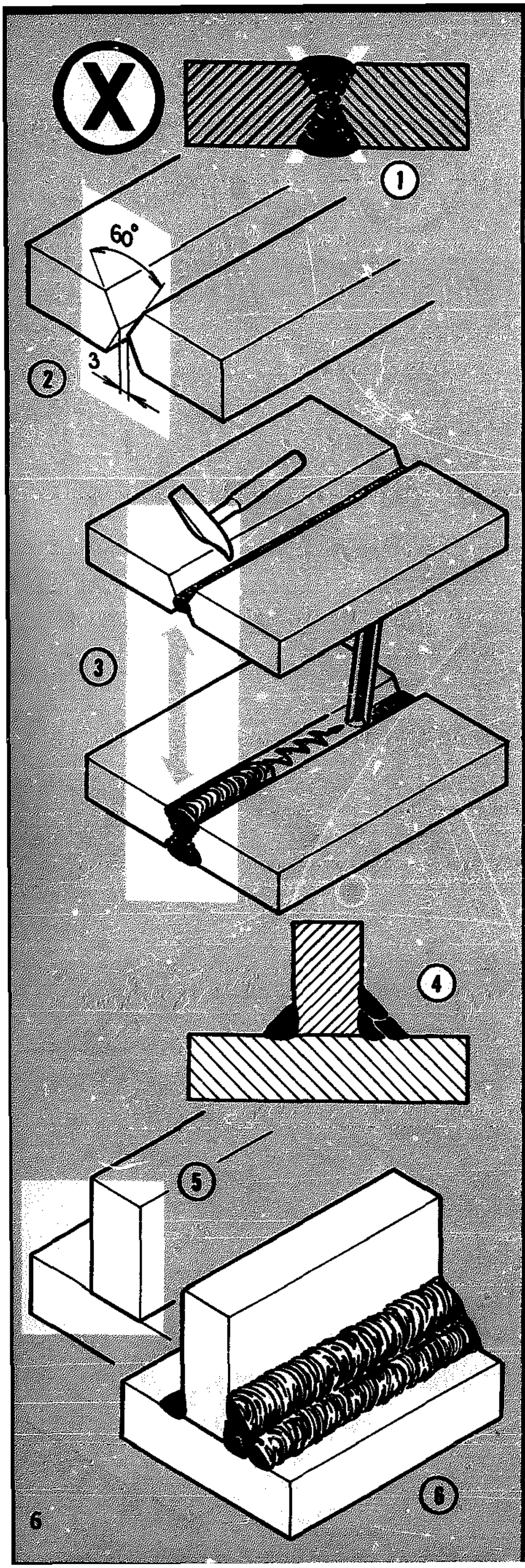
Sometimes a sealing run (after the weld is completed) or a backing run (after one or more previous runs) is made. Therefore the backside of the weld is gouged, cleaned and finished by one run. This is done in case of stringent requirements.

5
Single V-butt weld

6
Preparation

7
Welding





1
Double-V
butt weld

DOUBLE-V BUTT WELD

plate thickness	10-25 mm
included angle	60^{o}
root gap	3 mm

2
Preparation

3
Welding

Here too the weld is completed in several runs, always cleaning in between. When one or two runs have been made the workpiece is turned over, the backside gouged and cleaned and the welding proceeded.
The joint should be completed by welding both sides alternately.

4
Double
fillet weld

DOUBLE FILLET WELD

plate thickness	10-20 mm
root gap	none

5
Preparation

6
Welding

Dependant on the plate thickness each side of the weld is made in one or several runs. With more runs, welding is done alternately and before starting a new run the previous one must be cleaned first.

In fig. 1 the distance between electrode tip and workpiece after the arc has been struck is shown.
The penetration depends on the plate thickness of the electrode, the length of the arc, the position of the electrode and the welding current.

In figures 2, 3 and 4 three beads, produced with the same welding current but on different plate thicknesses, are shown.
In fig, 5 the effect of arc length and position of electrode is shown.

Gas welding is done either leftward or rightward.

Leftward welding is mostly done on thin plates.

Rightward welding on thick plates.

The flame should be correctly adjusted. If all the oxygen is used for burning the acetylene,the flame is called neutral. It is mostly used for steel. (Also for stainless steel and aluminium).
An excess of acetylene (fig. 11) is used in the flame for welding some non-ferrous metals.

In fig. 12 a flame with an excess of oxygen is shown. (Used for brasses).

1
Distance of electrode to work
2
Plate 1/2"
3
Plate 3/8"
4
Plate 1/4"

5
Position of electrode

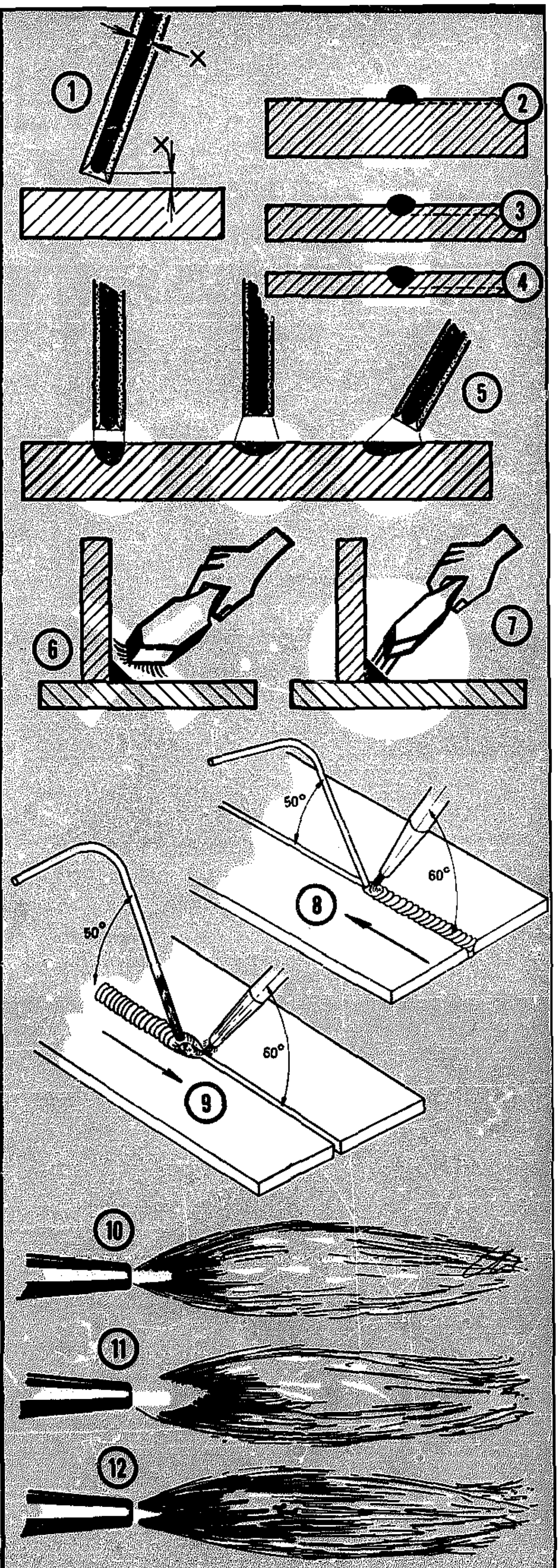
6
Broad steel wire brush: wrong!
7
Narrow steel wire brush: correct!

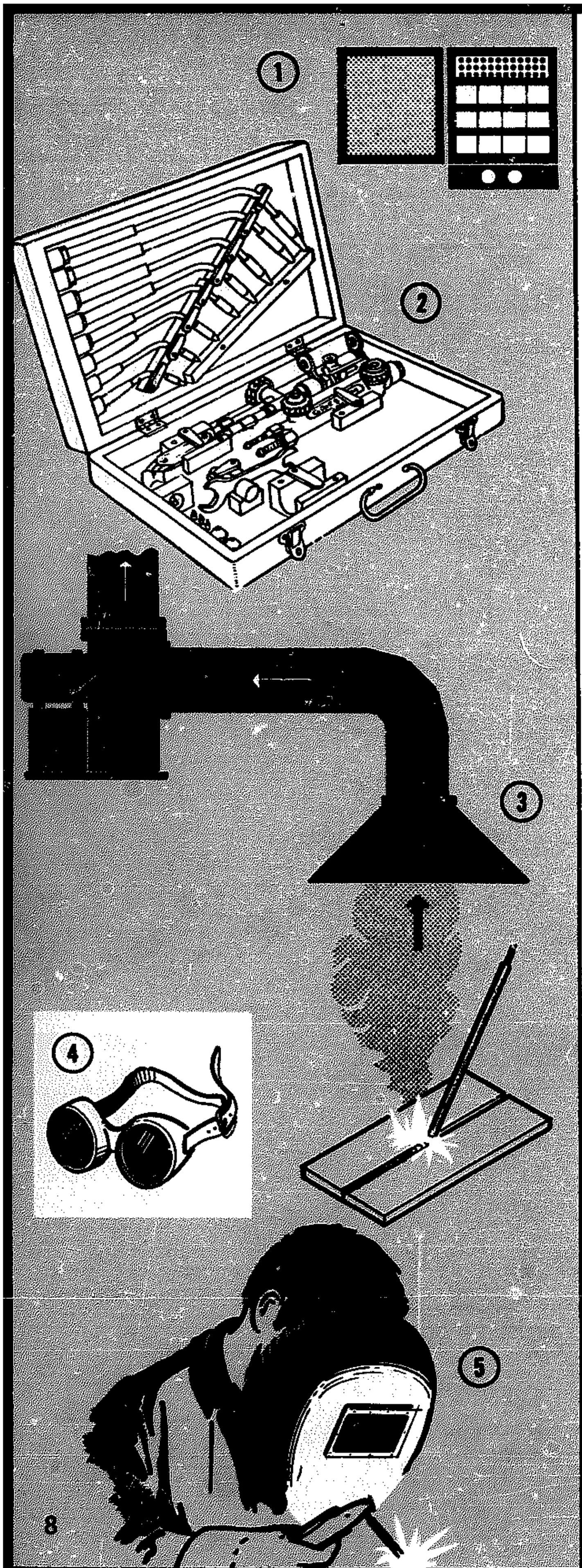
8
Leftward (or foreward welding)

9
Rightward (or backward welding)

10
Neutral flame

11
Excess of acetylene (carburizing flame)
12
Excess of oxygen (oxydizing flame)





1 Electrode cabinet	Store electrodes in an electrode cabinet. They remain dry there and the types are separated.
2 Set of torches and accessories	The torches are usually kept in a special box. The smallest torch is for thin metals, the largest for thick metals. Nozzles are specified by a number. Always put torches and accessories back in their places after use.
	SAFETY
3 Exhaust system	It is advisable that the fumes formed in continuous welding should be removed by means of an appropriate exhaust system.
4 Welding goggles	During gas welding always wear goggles, gloves and apron against rays and spatter.
5 Face shield	During arc welding use a face shield and gloves against harmful rays; also an apron against spatter.

ISBN 90 217 1024 2 WELDING