Extract:
Measuring Dovetail Slides
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American Machinists' Handbook

AND

DICTIONARY OF SHOP TERMS

A REFERENCE BOOK OF MACHINE-SHOP AND DRAWING-ROOM DATA, METHODS AND DEFINITIONS

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TAPERS PER FOOT IN INCHES AND CORRESPONDING ANGLES

Taper per Foot	Included Angle			Angle with Center Line			Taper per Foot	Included Angle			Angle with Center Line		
	Deg.	Min.	Sec	Deg.	Min.	Sec.		Deg.	Min.	Sec.	Deg.	Min.	Sec.
1/64	0	4	28	0	2	14	1	4	46	18	2	23	9
1/32	0	8	58	0	4	29	1 1/8	5	22	40	2	41	50
1/16	0	17	53	0	8	57	1 1/4	5	57	48	2	58	54
3/32	0	26	52	0	13	26	1 3/8	6	33	26	3	16	43
1/8	0	35	48	0	17	54	1 1/2	7	9	10	3	34	35
5/32	0	44	44	0	22	22	1 5/8	7	44	48	3	52	24
3/16	0	53	44	0	26	52	1 3/4	8	20	26	4	10	13
7/32	1	2	36	0	31	18	1 7/8	8	56	2	4	28	1
1/4	1	11	36	0	35	48	2	9	31	36	4	45	48
9/32	1	20	30	0	40	15	2 1/4	10	42	42	5	21	21
5/16	1	29	30	0	44	45	2 1/2	11	53	36	4	56	48
11/32	1	38	26	0	49	13	2 3/4	13	4	24	6	32	12
3/8	1	47	24	0	53	42	3	14	15	0	7	7	30
13/32	1	56	24	0	58	12	3 1/4	15	25	24	7	42	42
7/16	2	5	18	1	2	39	3 1/2	16	35	40	8	17	50
15/32	2	14	16	1	7	8	3 3/4	17	45	40	8	52	50
1/2	2	23	10	1	11	35	4	18	55	24	9	27	42
17/32	2	32	4	1	16	2	4 1/4	20	5	2	10	2	31
9/16	2	41	4	1	20	32	4 1/2	21	14	20	10	37	10
19/32	2	50	2	1	25	1	4 3/4	22	23	22	11	11	41
5/8	2	59	0	1	29	30	5	23	32	12	11	46	6
21/32	3	7	56	1	33	58	5 1/4	24	40	42	12	20	21
11/16	3	16	54	1	38	27	5 1/2	25	48	48	12	54	24
23/32	3	25	50	1	42	55	5 3/4	26	56	46	13	28	23
3/4	3	34	44	1	47	21	6	28	4	20	14	2	10
25/32	3	43	44	1	51	52	6 1/4	29	11	34	14	35	47
13/16	3	52	38	1	56	19	6 1/2	30	18	26	15	9	13
27/32	4	1	32	2	0	46	6 3/4	31	25	2	15	42	31
7/8	4	10	32	2	5	16	7	32	31	12	16	15	36
29/32	4	19	26	2	9	43	7 1/4	33	37	44	16	48	32
15/16	4	28	24	2	14	12	7 1/2	34	42	30	17	21	15
31/32	4	37	20	2	18	40	8	35	47	32	17	53	46
							8 1/4	36	52	12	18	26	6

TABLE FOR USE IN COMPUTING TAPERS

In the table on pages 810 and 811, the quantities when expressed in inches represent the taper per inch corresponding to various angles advancing by 10 minutes from 10 minutes to 90 degrees. If an angle is given as, say, 27½ degrees and it is desired to find the corresponding taper in inches, the amount, 0.4894, may be taken directly from the table. This is the taper per inch of length measured as in Fig. 6, along the axis. The taper in inches per foot of length is found by multiplying the tabulated quantity by 12, and in this particular case it would be 0.4894 inch × 12 = 5.8728 inches. Where the included angle is not found directly in the table, the taper

per inch is found as follows: Assume that the angle in question is 12¼ degrees, then the nearest angles in the table are 12 degrees 10 minutes and 12 degrees 20 minutes, the respective quantities tabulated under these angles being 0.21314 and 0.21610. The difference between the two is 0.00296, and as 12¼ degrees is half way

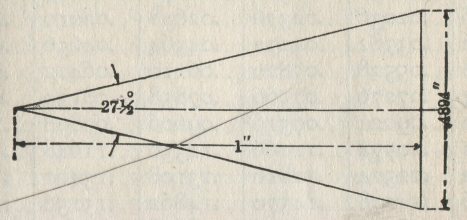

FIG. 6.—Taper per Inch and Corresponding Angle

between 12 degrees 10 minutes and 12 degrees 20 minutes one-half of 0.00296, or 0.00148 is added to 0.21314, giving 0.21462 inch as the taper of a piece 1 inch in length and of an included angle of 12¼ degrees. The taper per foot equals 0.21462 inch × 12 = 2.5754 inches.

TABLE FOR DIMENSIONING DOVETAIL SLIDES AND GIBS

The table on page 812 is figured for machine-tool work so as to enable one to tell at a glance the amount to be added or subtracted in dimensioning dovetail slides and their gibs for the usual angles up to 60 degrees. The column for 45-degree dovetails is omitted, as *A* and *B* would, of course, be alike for this angle.

In the application of the table, assuming a base with even dimensions, as in the sketch in Fig. 7, to obtain the dimensions *x* and *y* of the slide, Fig. 8, allowing for the gib which may be assumed to be ¼ inch thick, the perpendicular depth of the dovetail being ⅝ inch, and the angle 60 degrees, look under column *A* for ⅝ inch, and it will be found opposite this that *B* is 0.360 inch, which subtracted from 2 inches gives 1.640 inches, the dimension *x*. To find *y* first get the dimension 1.640 inches, then under the column for 60-degree gibs (where *C* is ¼ inch), *D* is found to be 0.289 inch, which is added to 1.640, giving 1.929 inches.

In practice, this dimension is usually made a little larger, say to the nearest 64th, to allow for fitting the gib.

MEASURING EXTERNAL AND INTERNAL DOVETAILS

The accompanying table of constants is for use with the plug method of sizing dovetail gages, etc. The constants are calculated for the plugs and angles most in use; and to use them a knowledge of arithmetic is all that is required. The formulas by which they were obtained are added for the convenience of those who may have an unusual angle to make.

As an example of the use of the table, suppose that *Z*, Fig. 9, is the dimension wanted, and that the dimension *A* and the angle *a* are

Table for Computing Tapers

The Tabulated Quantities = Twice the Tangent of Half the Angle.

Deg.	0′	10′	20′	30′	40′	50′	60′
0	.00000	.00290	.00582	.00872	.01164	.01454	.01746
1	.01746	.02036	.02326	.02618	.02910	.03200	.03492
2	.03492	.03782	.04072	.04364	.04656	.04946	.05238
3	.05238	.05528	.05820	.06110	.06402	.06692	.06984
4	.06984	.07276	.07566	.07858	.08150	.08440	.08732
5	.08732	.09024	.09316	.09606	.09898	.10190	.10482
6	.10482	.10774	.11066	.11356	.11648	.11940	.12232
7	.12232	.12524	.12816	.13108	.13400	.13694	.13986
8	.13986	.14278	.14570	.14862	.15156	.15448	.15740
9	.15740	.16034	.16326	.16618	.16912	.17204	.17498
10	.17498	.17790	.18084	.18378	.18670	.18964	.19258
11	.19258	.19552	.19846	.20138	.20432	.20726	.21020
12	.21020	.21314	.21610	.21904	.22198	.22492	.22788
13	.22788	.23082	.23376	.23672	.23966	.24262	.24556
14	.24556	.24852	.25148	.25444	.25738	.26034	.26330
15	.26330	.26626	.26922	.27218	.27516	.27812	.28108
16	.28108	.28404	.28702	.28998	.29296	.29592	.29890
17	.29890	.30188	.30486	.30782	.31080	.31378	.31676
18	.31676	.31976	.32274	.32572	.32870	.33170	.33468
19	.33468	.33768	.34066	.34366	.34666	.34966	.35266
20	.35266	.35566	.35866	.36166	.36466	.36768	.37068
21	.37068	.37368	.37670	.37972	.38272	.38574	.38876
22	.38876	.39178	.39480	.39782	.40084	.40388	.40690
23	.40690	.40994	.41296	.41600	.41904	.42208	.42512
24	.42512	.42816	.43120	.43424	.43728	.44034	.44338
25	.44338	.44644	.44950	.45256	.45562	.45868	.46174
26	.46174	.46480	.46786	.47094	.47400	.47708	.48016
27	.48016	.48324	.48632	.48940	.49248	.49556	.49866
28	.49866	.50174	.50484	.50794	.51004	.51414	.51724
29	.51724	.52034	.52344	.52656	.52966	.53278	.53590
30	.53590	.53902	.54214	.54526	.54838	.55152	.55464
31	.55464	.55778	.56092	.56406	.56720	.57034	.57350
32	.57350	.57664	.57980	.58294	.58610	.58926	.59242
33	.59242	.59560	.59876	.60194	.60510	.60828	.61146
34	.61146	.61464	.61782	.62102	.62420	.62740	.63060
35	.63060	.63380	.63700	.64020	.64342	.64662	.64984
36	.64984	.65306	.65628	.65950	.66272	.66596	.66920
37	.66920	.67242	.67566	.67890	.68216	.68540	.68866
38	.68866	.69192	.69516	.69844	.70170	.70496	.70824
39	.70824	.71152	.71480	.71808	.72136	.72464	.72794
40	.72794	.73124	.73454	.73784	.74114	.74446	.74776
41	.74776	.75108	.75440	.75774	.76106	.76440	.76772
42	.76772	.77106	.77442	.77776	.78110	.78446	.78782
43	.78782	.79118	.79454	.79792	.80130	.80468	.80806
44	.80806	.81144	.81482	.81822	.82162	.82502	.82842
45	.82842	.83184	.83526	.83866	.84210	.84552	.84894

Table for Computing Tapers

The Tabulated Quantities = Twice the Tangent of Half the Angle.

Deg.	0′	10′	20′	30′	40′	50′	60′
46	.84894	.85238	.85582	.85926	.86272	.86616	.86962
47	.86962	.87308	.87656	.88002	.88350	.88698	.89046
48	.89046	.89394	.89744	.90094	.90444	.90794	.91146
49	.91146	.91496	.91848	.92202	.92554	.92908	.93262
50	.93262	.93616	.93970	.94326	.94682	.95038	.95396
51	.95396	.95752	.96110	.96468	.96828	.97186	.97546
52	.97546	.97906	.98268	.98630	.98990	.99354	.99716
53	.99716	1.00080	1.00444	1.00808	1.01174	1.01538	1.01906
54	1.01906	1.02272	1.02638	1.03006	1.03376	1.03744	1.04114
55	1.04114	1.04484	1.04854	1.05226	1.05596	1.05970	1.06342
56	1.06342	1.06716	1.07090	1.07464	1.07840	1.08214	1.08592
57	1.08592	1.08968	1.09346	1.09724	1.10102	1.10482	1.10862
58	1.10862	1.11242	1.11624	1.12006	1.12388	1.12770	1.13154
59	1.13154	1.13538	1.13924	1.14310	1.14696	1.15082	1.15470
60	1.15470	1.15858	1.16248	1.16636	1.17026	1.17418	1.17810
61	1.17810	1.18202	1.18594	1.18988	1.19382	1.19776	1.20172
62	1.20172	1.20568	1.20966	1.21362	1.21762	1.22160	1.22560
63	1.22560	1.22960	1.23362	1.23764	1.24166	1.24570	1.24974
64	1.24974	1.25378	1.25784	1.26190	1.26598	1.27006	1.27414
65	1.27414	1.27824	1.28234	1.28644	1.29056	1.29468	1.29882
66	1.29882	1.30296	1.30710	1.31126	1.31542	1.31960	1.32378
67	1.32378	1.32796	1.33216	1.33636	1.34056	1.34478	1.34902
68	1.34902	1.35326	1.35750	1.36176	1.36602	1.37028	1.37456
69	1.37456	1.37984	1.38314	1.38744	1.39176	1.39608	1.40042
70	1.40042	1.40476	1.40910	1.41346	1.41782	1.42220	1.42658
71	1.42658	1.43098	1.43538	1.43980	1.44422	1.44864	1.45308
72	1.45308	1.45754	1.46200	1.46646	1.47094	1.47542	1.47992
73	1.47992	1.48442	1.48894	1.49348	1.49800	1.50256	1.50710
74	1.50710	1.51168	1.51624	1.52084	1.52544	1.53004	1.53466
75	1.53466	1.53928	1.54392	1.54856	1.55322	1.55790	1.56258
76	1.56258	1.56726	1.57196	1.57668	1.58140	1.58612	1.59088
77	1.59088	1.59562	1.60040	1.60516	1.60996	1.61476	1.61966
78	1.61956	1.62440	1.62922	1.63406	1.63892	1.64380	1.64868
79	1.64868	1.65356	1.65846	1.66338	1.66830	1.67324	1.67820
80	1.67820	1.68316	1.68814	1.69312	1.69812	1.70314	1.70816
81	1.70816	1.71320	1.71824	1.72332	1.72836	1.73348	1.73858
82	1.73858	1.74368	1.74882	1.75396	1.75910	1.76428	1.76946
83	1.76946	1.77464	1.77984	1.78506	1.79030	1.79554	1.80080
84	1.80080	1.80608	1.81138	1.81668	1.82198	1.82732	1.83266
85	1.83266	1.83802	1.84340	1.84878	1.85418	1.85960	1.86504
86	1.86504	1.87048	1.87594	1.88142	1.88690	1.89240	1.89792
87	1.89792	1.90346	1.90902	1.91458	1.92016	1.92576	1.93138
88	1.93138	1.93700	1.94266	1.94832	1.95400	1.95968	1.96540
89	1.96540	1.97112	1.97686	1.98262	1.98840	1.99420	2.00000
90	2.						

Refer to page 808 for explanation of table.

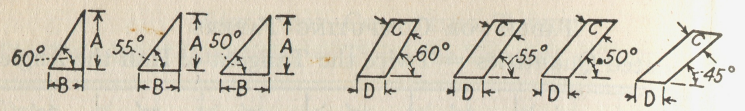

TABLE FOR DIMENSIONING DOVETAIL SLIDES AND GIBS

A	B	B	B	C	D	D	D	D
$\frac{1}{32}$″	.018″	.022″	.027″	$\frac{1}{8}$″	.144″	.152″	.163″	.176″
$\frac{1}{16}$″	.036″	.044″	.053″	$\frac{3}{16}$″	.216″	.228″	.244″	.264″
$\frac{1}{8}$″	.072″	.087″	.105″	$\frac{1}{4}$″	.289″	.305″	.326″	.353″
$\frac{1}{4}$″	.144″	.175″	.210″	$\frac{5}{16}$″	.361″	.381″	.407″	.442″
$\frac{3}{8}$″	.216″	.262″	.314″	$\frac{3}{8}$″	.433″	.457″	.489″	.530″
$\frac{1}{2}$″	.288″	.350″	.420″	$\frac{1}{2}$″	.577″	.610″	.652″	.707″
$\frac{5}{8}$″	.360″	.437″	.525″	$\frac{5}{8}$″	.721″	.762″	.815″	.883″
$\frac{3}{4}$″	.433″	.525″	.629″	$\frac{3}{4}$″	.866″	.915″	.979″	1.060″
$\frac{7}{8}$″	.505″	.612″	.734″	$\frac{7}{8}$″	1.010″	1.067″	1.142″	1.237″
1″	.577″	.700″	.839″	1″	1.154″	1.220″	1.305″	1.414″
$1\frac{1}{8}$″	.649″	.787″	.944″					
$1\frac{1}{4}$″	.721″	.875″	1.049″					
$1\frac{3}{8}$″	.794″	.962″	1.153″					
$1\frac{1}{2}$″	.866″	1.050″	1.259″					
$1\frac{3}{4}$″	1.010″	1.225″	1.469″					
2″	1.154″	1.400″	1.677″					
$2\frac{1}{4}$″	1.298″	1.575″	1.888″					
$2\frac{1}{2}$″	1.442″	1.750″	2.097″					
$2\frac{3}{4}$″	1.588″	1.925″	2.307″					
3″	1.732″	2.100″	2.517″					
$3\frac{1}{2}$″	2.020″	2.450″	2.937″					
4″	2.308″	2.800″	3.356″					
$4\frac{1}{2}$″	2.598″	3.150″	3.776″					
5″	2.885″	3.501″	4.195″					

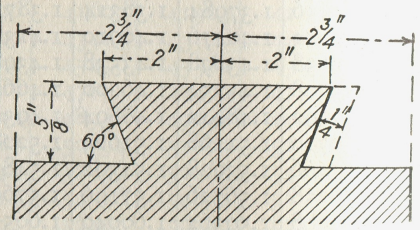

FIG. 7

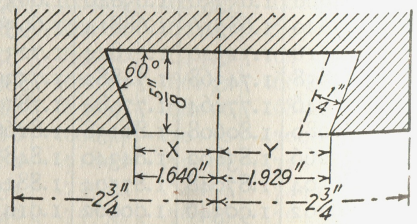

FIG. 8
Dimensioning Slides and Gibs

known. A glance at the formulas below shows that $Z = A - D$. Then the constant D corresponding to the size of plug and the angle used is subtracted from A and the remainder equals Z. For instance, if $A = 4$ inches, the plug used = $\frac{3}{8}$ inch, and the angle = 30 degrees, then $Z = A - D = 4$ inches − 1.0245 inches = 2.9755 inches.

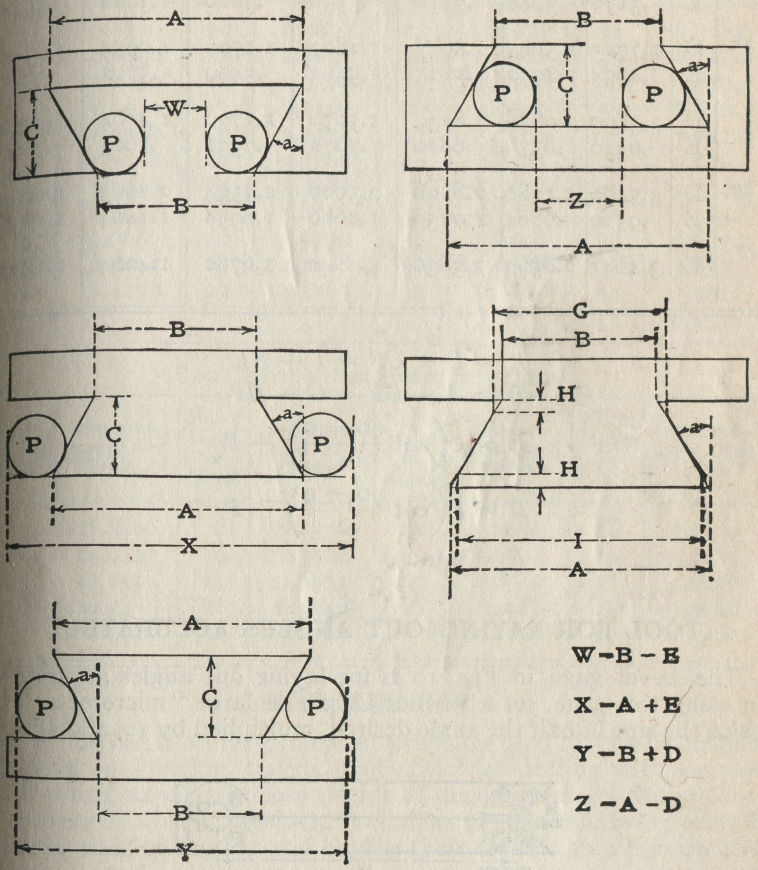

FIG. 9.—External and Internal Dovetails

If A is not known, but B and C are given, as in the formula below the table (page 814), $A = B + CF$. Then if $B = 3.134$ inches, $C = \frac{3}{4}$ inch, and the angle is 30 degrees, as before; $A = B + CF =$ 3.134 inches + (0.75 inch × 1.1547) = 4 inches, whence Z can be found, as already shown.

If the corners of the dovetail are flat, as shown in Fig. 9 at I and G, and the dimensions I and H and the angles are known, it will be found from the formulas below the table that A also $= I + HF$; so that, if $I = 3.8557$ inches, $H = \frac{1}{8}$ inch, and the angle = 30 degrees; then $A = I + HF = 3.8557$ inches + (0.125 inch × 1.1547) = 4 inches, from which Z is found as before.

CONSTANTS FOR DOVETAILS

Plug		60°	55°	50°	45°	40°	35°	30°
1/4″	D	1.1830	1.0429	.9368	.8535	.7861	.7302	.6830
	E	.3170	.3288	.3410	.3536	.3666	.3802	.3943
3/8″	D	1.7745	1.5643	1.4053	1.2803	1.1792	1.0954	1.0245
	E	.4755	.4932	.5115	.5303	.5499	.5702	.5915
1/2″	D	2.3660	2.0858	1.8730	1.7070	1.5722	1.4604	1.3660
	E	.6340	.6576	.6820	.7072	.7332	.7603	.7886
3/4″	D	3.5490	3.1286	2.8106	2.5606	2.3584	2.1903	2.0490
	E	.9510	.9864	1.0230	1.0606	1.0998	1.1404	1.1830
	F	3.4641	2.8563	2.3836	2	1.6782	1.4004	1.1547

$$A = B + CF = I + HF$$
$$B = A - CF = G - HF$$
$$E = P\left(\cot \frac{90 + a}{2}\right) + P$$
$$D = P\left(\cot \frac{90 - a}{2}\right) + P$$
$$F = 2 \tan a$$

TOOL FOR LAYING OUT ANGLES ACCURATELY

The bevel gage in Fig. 10 is for laying out angles accurately. In using this gage, set a vernier caliper or large "micrometer" to twice the sine of half the angle desired, multiplied by 10, add $\frac{1}{2}$ inch,

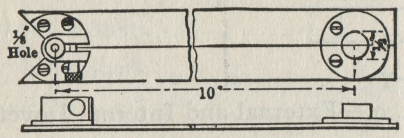

FIG. 10.—Bevel Gage for Laying Out

and open the gage till it fits the vernier. This gives the angle within the limits of the measuring tool and the radius of the gage. The $\frac{1}{8}$-inch hole in the center is for a setting plug when it is desirable to lay out an angle from a given center.

The table gives the measurements over the half discs required for setting the arms of the gage to give any angle from 1 to 45 degrees, and also the setting for any number of holes in a circle from 3 to 22.

TABLE FOR SETTING TOOL FOR LAYING OUT ANGLES

GAGE SETTING FOR EVEN DEGREES

Angle Degrees	Measurement Over Disks	Angle Degrees	Measurement Over Disks	Angle Degrees	Measurement Over Disks	Angle Degrees	Measurement Over Disks
1	0.6746	12	2.5906	23	4.4874	34	6.3474
2	0.8490	13	2.764	24	4.6582	35	6.5142
3	1.0236	14	2.9374	25	4.8288	36	6.6804
4	1.1980	15	3.1106	26	4.9980	37	6.846
5	1.3724	16	3.2834	27	5.1690	38	7.0114
6	1.5468	17	3.4562	28	5.3384	39	7.1762
7	1.7210	18	3.6286	29	5.5176	40	7.3404
8	1.8952	19	3.8010	30	5.6764	41	7.5042
9	2.0692	20	3.9730	31	5.8448	42	7.6674
10	2.2432	21	4.1448	32	6.0128	43	7.830
11	2.4170	22	4.3162	33	6.1804	44	7.9922
						45	8.1536

GAGE SETTINGS FOR HOLES IN A CIRCLE

No. of Holes in Circle	Measurement Over Disks	No. of Holes in Circle	Measurement Over Disks	No. of Holes in Circle	Measurement Over Disks	No. of Holes in Circle	Measurement Over Disks
3	17.8206	8	8.1536	13	5.2864	18	3.9730
4	14.6422	9	7.3404	14	4.9504	19	3.7918
5	12.2558	10	6.6802	15	4.6582	20	3.6286
6	10.5	11	6.1346	16	4.4018	21	3.4808
7	9.1776	12	5.6762	17	4.1750	22	3.3462

THE SINE BAR

The sine bar is an instrument of precision used by the toolmaker in laying out, setting, testing, and otherwise dealing with angular work which requires a close degree of accuracy in its dimensions. It consists of a bar of steel with two discs of equal diameter secured near the ends of the bar and having their centers on a line exactly

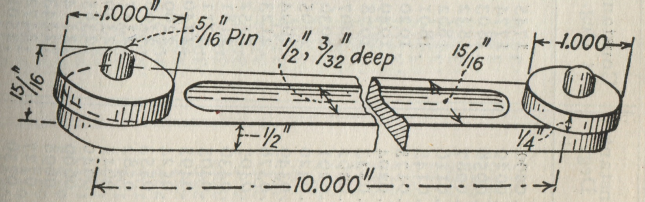

FIG. 11.—Ten-Inch Sine Bar

parallel with the edge of the sine bar. The bar itself may be either tool steel hardened and ground or machine steel case hardened.

An improved form of sine bar is shown in Fig. 11. There are various other designs, all having for their object a convenient means