HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

Toolmaker.—Can you give me any information in regard to the Jarno taper? Are there any tables available anywhere for this taper, the same as for the Morse and the Brown & Sharpe standard tapers? What is the Jarno taper used for?

A.—The Jarno taper was proposed several years ago by Mr. Oscar J. Beale of the Brown & Sharpe Co. The taper per foot of all the Jarno taper sizes is 0.600 inch on the diameter. The Jarno taper has the advantage over the other two standard tapers mentioned in the above question in that there is an exact relationship between the diameter of the large end, the diameter of the small end and the length between the places where these diameters are measured, and this relationship can be expressed by simple formulas. The sizes of the Jarno tapers are known by numbers from 2 and upwards, and by simply designating the number of the taper, all other necessary dimensions can be determined by means of the formulas.

Let N = the number of Jarno taper,
D = the diameter of the large end,
d = the diameter of the small end, and
L = the length of the taper.

Then, $D = \frac{N}{8}$, $d = \frac{N}{10}$, $L = \frac{N}{2}$

If, for instance, we want to determine the size of a No. 7 Jarno taper, we find from our formulas that the diameter of the large end is ⅞, the diameter of the small end 0.700 and the length 3½ inches. If we figure the taper, we will find it to be 0.600 inch per foot, as stated before. As far as we know, there are no tables available outside of the manufacturing establishments where this taper is used, but on account of the simplicity of figuring the dimensions for the taper, no tables are actually required. This taper, although it has some very decided merits on account of being, one might well say, the only system of standard tapers founded on a scientific method, has not been used to any great extent. The Pratt & Whitney Co. has commenced to use it of late for several of their new designs of machines, particularly profiling machines, but it is safe to say that the old standard tapers, the Morse and the Brown & Sharpe do still hold their own in almost all ordinary machine shop practice.

C. K.—Kindly work out the spiral gearing problems indicated in Fig. 1; for each of the two cases the ratio is 1 : 1. The shafts are at right angles and the gears are to run at about 500 revolutions per minute. Also, will you please look over the following dimensions given for a pair of spiral

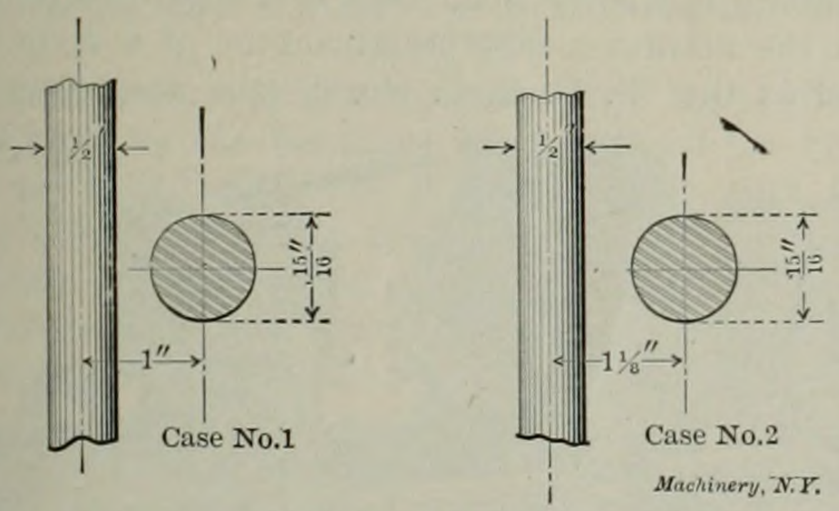

Fig. 1.

gears of equal dimensions: Twelve teeth each, 14 diametral pitch cutter, shaft angle 90 degrees, gear ratio 1 : 1, and tooth 45 degrees with axis. I make it the pitch diameter of these gears should be 1.212 inch, that the outside diameter should be 1.355 inch, and that the lead should be 3.808 inch.

The answers given below were obtained by the process described in the article on the subject of spiral gears, published in the May, 1906, issue of MACHINERY; reference should be made to this. The conditions shown in our correspondent's sketch in Fig. 1 hold us within very close limits as to diameters for these gears. We will take it for granted that the gears are to be made integral with the shafts on which they are mounted, otherwise they would merely be thin shells of no strength whatever. It is our object, then, to give them such pitch diameters that they will accurately fill the center distance given, and will be enough larger than the shafts of which they are a part to make it unnecessary to cut into these shafts when milling the teeth. The diagram for case No. 1, Fig. 2, shows these conditions fulfilled. This method of preliminary graphical solution requires that the ratio line for this case should be drawn at an angle of 45 degrees with the axis lines. The following dimensions have been worked out to fit the diagram, in accordance with the rules or formulas given in the article previously referred to:

	Gear on Large Shaft.	Gear on Small Shaft.
Number of teeth	12	12
Diametral pitch	18	18
Tooth angle	56° 10′	33° 50′
Pitch diameter	1.197 inch	0.803 inch
Outside diameter	1.308 inch	0.914 inch
No. of cutter used	No. 2	No. 5
Lead of spiral	2.521 inch	3.764 inch
Thickness of tooth	0.0873 inch	
Addendum	0.0555 inch	
Whole depth of tooth	0.120 inch	

The second case, of which a diagram is also shown in Fig. 2, may be given the same number of teeth and the same tooth

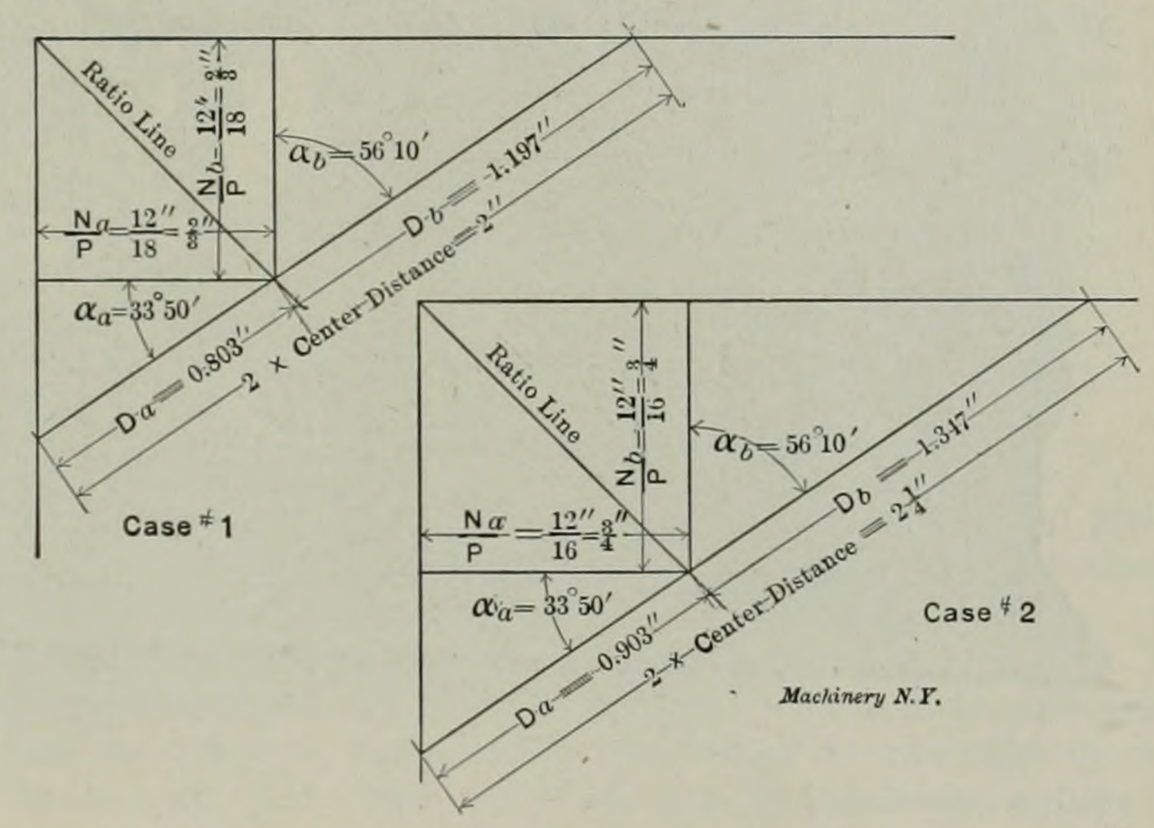

Fig. 2.

angles. This pair will in fact be merely that of case 1 on a slightly larger scale. The complete dimensions will be as follows:

	Gear on Large Shaft.	Gear on Small Shaft.
Number of teeth	12	12
Diametral pitch	16	16
Tooth angle	56° 10′	33° 50′
Pitch diameters	1.347 inch	0.903 inch
Outside diameter	1.472 inch	1.028 inch
No. of cutter used	No. 2	No. 5
Lead of spiral	2.836 inch	4.232 inch
Thickness of tooth	0.0982 inch	
Addendum	0.0625 inch	
Whole depth of tooth	0.135 inch	

It is conceivable that you might have good reason for wanting the pitch in these teeth different or for wanting their diameters changed slightly, in which case it would be possible to get new solutions to accommodate the conditions desired.

The dimensions you have given for the 45-degree angle gears are correct.

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A combination wood and steel railway tie has been invented by Mr. Thomas A. Galt, Sterling, Ill., which is claimed to have a number of superior advantages. The steel portion consists of two parallel channels, lying on edge, with the flanged sides in and separated by a distance of about 8 inches. Firmly clamped between the channels by four through bolts are two sections of ordinary wood tie, each about 2 feet long, 8 inches wide and 6 inches deep. The combination affords the same simple spiking condition as the ordinary wood tie and the same elasticity. Samples of these ties have been placed in the main line of the Chicago & Northwestern R. R., in Sterling, Ill. It is asserted that the facilities for tamping the ties with the open channel bar construction are superior to the ordinary wooden tie.