MINIATURE COUPLINGS—Couplicon® 1

by Masahide Satoh*

Introduction

As a means of connecting shafts, couplings have been used for a long time. One that has been market in great numbers is the flexible coupling, which al-lows for angular misalignment.

The primary purpose of couplings is to transmit torque while allowing for misalignment. However, transmitting the rotation angle exactly is becoming an increasingly important aim.

Particularly with miniature couplings, the cases in which exact rotation angle transmission is the primary purpose has increased in recent years along with number of precise position settings.

More than ever, users demand exact rotation angle transmission from economical miniature couplings used in servomotors and stepping-motors. An outline of NBK's miniature coupling, the Couplicon® 1, follows.

Basic Principles

This newly developed flexible coupling has a simple structure made up of slits in its cylindrical body. But founded in the basic principles to be explained here, it possesses high torsional stiffness and flexibility.

Photo 1: Couplicon® 1

Figure 1 shows the cylinder with the slits cut side-by-side and facing each other. With the narrow slits the thin plates thus formed, should one end of the cylinder be fixed, the effect of an external force can be thought as one side of the leaf springs fixed and the other three sides free. The external force joins with the fixed side and the opposing free sides.

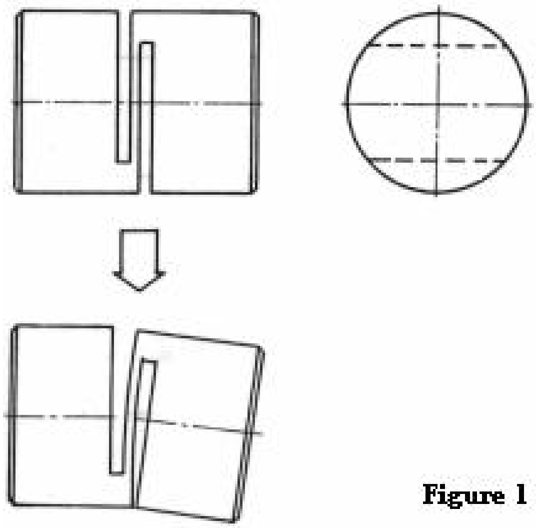

Figure 1

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Structurally speaking, when the load on the leaf springs is level, and there is no buckling, there is very little bend.

When there is an external force, if the cylinder twists only around the center, the leaf springs bear the load. Because the helix angle in the cylinder is very small, the coupling is said to high torsional stiffness.

Couplings are often, though, in conditions in which misalignment compels them to bend. Because the coupling rotates and the size and direction changes, only one leaf has the direction of the bend, the bend-induced load is great. So, the coupling is formed by crossing the leaf with another layer (as in Figure 2), making the rotation symmetrical.

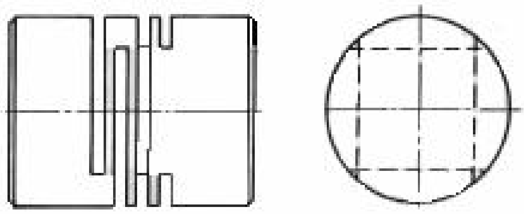

Figure 2

There is no problem with this two layer spring coupling so long as there is only angular misalignment.

Because usually there is also parallel misalignment, two more layers must be added as in Figure 3.

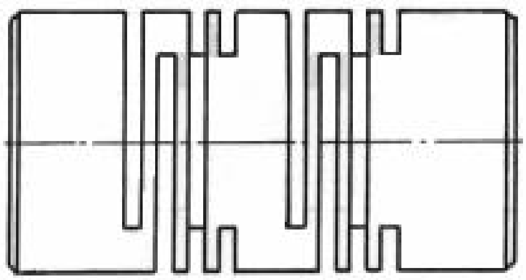

Figure 3

While a two layer leaf spring can only allow for angular misalignment, adding these two additional layers allows for parallel misalignment while angular misalignment is in the opposite direction (Figure 4).

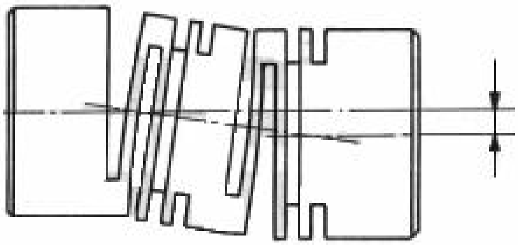

Figure 4

In this way, because fundamentally the Couplicon® 1 has four layers, there are eight slits in the structure.

Features

Zero backlash. Because the coupling is one piece and only allows for misalignment by the elastic change shape, there is no slipping or friction between parts, nor does it have the common wobbliness. Thus, it is maintenance-free and has no backlash.

High torsional stiffness. Due to the leaf spring structure, torsional stiff-ness is very high for small misalignments. Although it depends upon the material, the torsional stiffness generally matches that of the shaft it is attached to.

Allowance of shaft misalignment. Parallel misalignment, angular misalignment, and end-play are perfectly compensated for by the elastic distortion of leaf springs. Also, because the load incurred by misalignment (i.e. the elasticity force) is small, there is little load imposed on the bearings of the shaft.

Freedom of design and ease of production. Flexibility is determined by the width and the pitch of the eight slits. Therefore, it is easy to produce the Couplicon® 1 according to device specifications—like the one in Figure 5 when parallel misalignment is great,

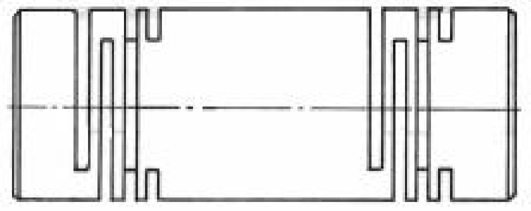

Figure 5

or the one in Figure 2 when there is only angular misalignment. Still more, the material can be changed to aluminum alloy for light-weight, or stainless steel for corrosion-resistance.

Form and dimensions

At NBK we have standardized four types of the Couplicon® 1 with outer diameters ranging from ø16 to ø32. Our customers can choose either aluminum alloy or stainless steel, and either the setscrew type or the clamping type (Figure 6). We have a total of 48 bore sizes among all the products.

The measurement and performance specifications is shown in Table 1 (next page).

Conclusion

As outlined above, high torsional stiffness is realized through a simple structure and a way of thinking.

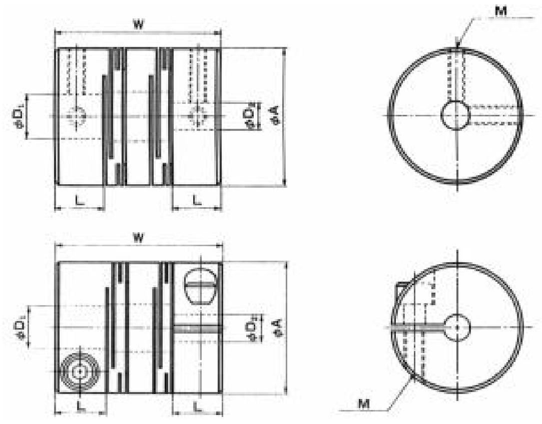

Figure 6

Precise positioning settings that use miniature couplings are thought to be on the rise. However, forecasts indicate a rise in the demand for high quality and low price miniature couplings

Choosing the most suitable miniature coupling from the many on the market is not easy, but the Couplicon® 1 combines high quality, low cost, and flexibility to the user's needs.

Photo 2: Specification-specific Couplicon® 1

Table 1: Coupling® 1 specifications *S—stainless steel *C—clamping style

Catalog Number*	A	L	W	M	Rated Torq. (kgf•cm)	Max. Rev. (rpm)	Wt. (gf)	Mom. of Inertia GD^2 ($kgf•cm^2$)	Static Torsional Stiffness (kgf•cm/rad)	Errors of Eccen. (mm)	Err. of Ang. (deg)	Errors of End-Play (mm)	Stock Bores D_1xD_2			
MST-16	16	7	23	M3	3	24000	10	0.014	210	0.1	2	±0.4	4x4	5x5	5x6	6x6
MST-20	20	8	26	M3	5	19000	20	0.0388	700	0.1	2	±0.4	5x5	6x6	6x8	8x8
MST-25	25	9	31	M4	10	15000	35	0.133	1100	0.15	2	±0.5	6x6	8x8	8x10	10x10
MST-32	32	13	41	M4	20	12000	75	0.409	2900	0.2	2	±0.6	8x8	10x10	10x12	12x12
MSTS-16	16	7	23	M3	5	24000	25	0.035	630	0.1	2	±0.3	4x4	5x5	5x6	6x6
MSTS-20	20	8	26	M3	10	19000	45	0.0873	2100	0.1	2	±0.3	5x5	6x6	6x8	8x8
MSTS-25	25	9	31	M4	20	15000	90	0.342	7000	0.15	2	±0.4	6x6	8x8	8x10	10x10
MSTS-32	32	12	41	M4	35	12000	190	1.04	8600	0.2	2	±0.5	8x8	10x10	10x12	12x12
MST-16C	16	7	23	M2.6	3	6500	10	0.014	210	0.1	2	±0.4		5x5		6x6
MST-20C	20	8	26	M2.6	5	7600	20	0.0388	700	0.1	2	±0.4		6x6		8x8
MST-25C	25	9	31	M3	10	6100	35	0.133	1100	0.15	2	±0.5		8x8		10x10
MST-32C	32	13	41	M4	20	4800	75	0.409	2900	0.2	2	±0.6		10x10		12x12
MSTS-16C	16	7	23	M2.6	5	9500	25	0.035	630	0.1	2	±0.3		5x5		6x6
MSTS-20C	20	8	26	M2.6	10	7600	45	0.0873	2100	0.1	2	±0.3		6x6		8x8
MSTS-25C	25	9	31	M3	20	6100	90	0.342	7000	0.15	2	±0.4		8x8		10x10
MSTS-32C	32	12	41	M4	35	4800	190	1.04	8600	0.2	2	±0.5		10x10		12x12