Glenn Research Center
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Technical Support Package

Offset Compound Gear Drive

NASA Tech Briefs
LEW-18340-1

National Aeronautics and
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Technical Support Package

for

OFFSET COMPOUND GEAR DRIVE

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NASA Tech Briefs

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Offset Compound Gear Drive

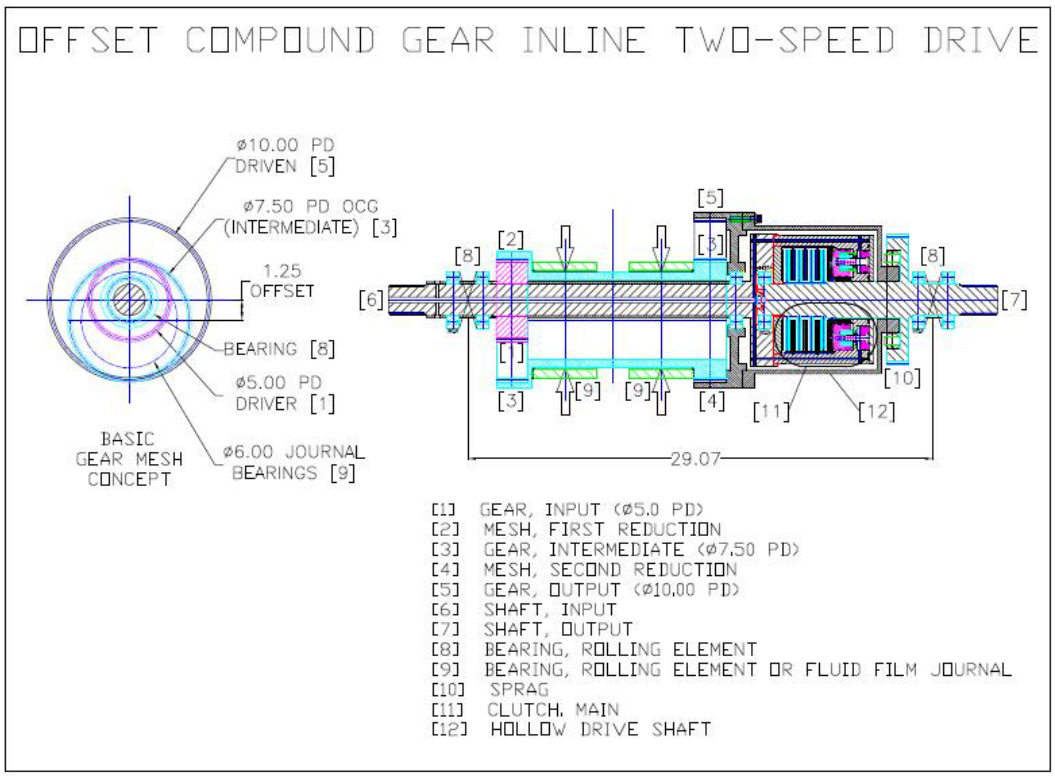
The Offset Compound Gear Drive is an in-line discrete two-speed device utilizing a special offset compound gear which has both internal tooth configuration on the input end and external tooth configuration on the output end, thus allowing it to mesh in series simultaneously with both a smaller external tooth input gear and a larger internal tooth output gear. The above geometry permits the compound gear to be offset while meshing with the smaller diameter input gear and the larger diameter output gear, both of which are on the same centerline resulting in a compact in-line reduction gear set comprised of only three gears. The figure, shows a representative scaled configuration for a 2:1 ratio low range output.

For the depicted scale, low speed operation is accomplished in two meshes: a Ø5.0 PD input gear [1] to Ø7.50 PD (internal tooth) intermediate gear [3] (0.667 reduction mesh) [2], and a Ø 7.50 PD (external tooth) intermediate gear [3] to a Ø10.00 PD output gear [5] (0.750 reduction mesh) [4]. The resultant low speed ratio is 2:1, (output speed = 0.500 = 0.667 stage one reduction [2] x 0.750 stage two reduction [4]).

Both the input shaft [6] and output shaft [7] spin on rolling element bearings [8] while the intermediate gear shaft (offset compound gear) [3] may spin on either fluid film journal bearings or rolling-element bearings [9].
From output gear [5], power is transmitted through hollow drive shaft [12] which in turn, drives a sprag [10] during which time the main clutch [11] is disengaged.

High speed operation, 1:1 ratio, is direct drive thru the main clutch [11]. During this mode of operation, the above gear train free-wheels an overrunning sprag [10]. A slight reduction in input speed is required to overrun the sprag [10]. The above gear train always spins. An alternative to spinning these gears in both speed ranges might employ the sprag at the forward end of the gear mesh allowing the gear train to quasi-idle when not transferring power.

The configuration was conceived to meet a rotorcraft drive design objective to provide a 50% reduction ratio. The configuration does so in two stages, or meshes, utilizing only three gears replacing multiple planet gears required in conventional planetary stages. A 50% reduction cannot be obtained in a single stage two mesh simple planetary gear configuration. In addition, ratios other than 50% can be configured to meet specific design requirements. This configuration overcomes the technical design challenge of a simple and robust two-speed/variable-speed driveline transmission that is light weight yet capable of transferring high power at high speed for next generation rotary wing aircraft which are forecast to require speed range variations on the order of 50%.


OFFSET COMPOUND GEAR INLINE TWO-SPEED DRIVE
ø10.00 PD
DRIVEN [5]
ø7.50 PD OCG
(INTERMEDIATE) [3]
1.25
OFFSET
BEARING [8]
ø5.00 PD
DRIVER [1]
ø6.00 JOURNAL
BEARINGS [9]
BASIC
GEAR MESH
CONCEPT
[5]
[8]
[2]
[3]
[8]
[6]
[7]
[1]
[10]
[9]
[9]
[3]
[4]
[11]
[12]
29.07
[1] GEAR, INPUT (ø5.0 PD)
[2] MESH, FIRST REDUCTION
[3] GEAR, INTERMEDIATE (ø7.50 PD)
[4] MESH, SECOND REDUCTION
[5] GEAR, OUTPUT (ø10.00 PD)
[6] SHAFT, INPUT
[7] SHAFT, OUTPUT
[8] BEARING, ROLLING ELEMENT
[9] BEARING, ROLLING ELEMENT OR FLUID FILM JOURNAL
[10] SPRAG
[11] CLUTCH, MAIN
[12] HOLLOW DRIVE SHAFT