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PLAN AND STUDY OF DIAPHRAGM SPRING OF A SINGLE PLATE DRY CLUTCH

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Abstract:
A Clutch could be a machine part accustomed connect a driving shaft to the driven shaft, in order that the driven shaft is often given power or stopped at wheel, without stopping the driving shaft. Clutches square measure designed for the transfer of most torsion from the engine with minimum heat generation. During engagement associated disengagement the 2 clutch discs have an axial slippy motion between them. The clutch is allowed to have interaction the transmission bit by bit solely with an exact quantity of slippage between the regulator and therefore the pressure plate. The paper contains the planning and analysis of diaphragm spring used for the generation of clamping load. The design of single plate clutch is completed for Force Motors New Vehicle and is drawn by exploitation theoretical calculation results. For planning of the diaphragm spring, 3d modelling code used is CATIA V5.0. Structural analysis is completed to seek out the strain distribution on the model. With the analysis results, we tend to check whether or not the planning is safe or not, examination the result with theoretical calculation and theoretical results. For structural analysis, HYPERMESH software is used.

Keywords. Clutches, pressure plate, Structural analysis, 3d modelling,.etc

I. Introduction

In clutch cowl assembly, the diaphragm spring is put in between the pressure plate and therefore the cowl stamping or cowl casting. The diaphragm spring contracts the quilt stamping (or cover pin elements) and pressure plate at specific pin diameters. In this configuration the diaphragm spring creates a clamping load through the pressure plate pin and provides a lever magnitude relation B/A, through that a unleash load R are often applied to disengage the clutch (clamp load). Clamp load and unleash load square measure connected through the lever magnitude relation, as square measure pressure plate travel and unleash bearing travel. Understanding these load and travel relationships can type the premise for understanding the essential functioning of the diaphragm spring clutch. The release bearing contacts the diaphragm spring levers at a fixed contact diameter. The pressure plate contacts

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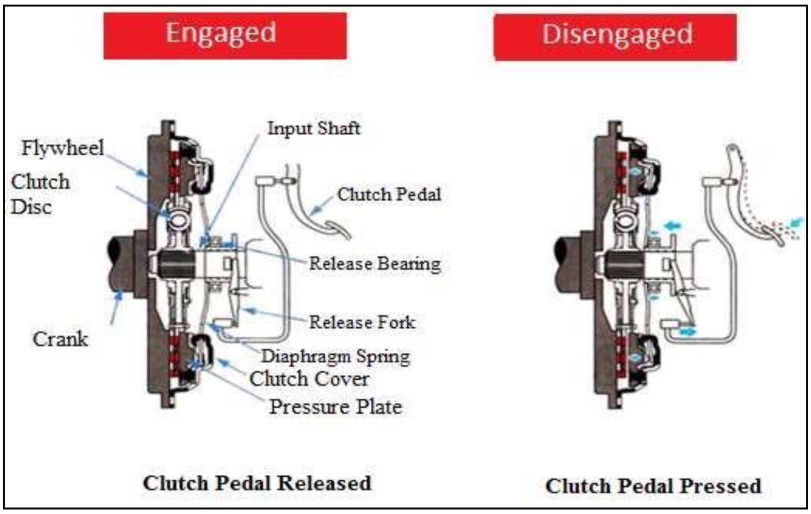
the diaphragm spring at a fixed pin diameter. The force of the diaphragm spring (clamp load) is transferred through the pressure plate at his purpose, called the pressure plate pin. This point is additionally typically referred to as the cam, as a result of the motion of diaphragm spring over this space. The pressure pate stays involved with the diaphragm spring through the force of clutch cowl drive straps, or by clips that physically hold the diaphragm spring to the pressure plate

II. Function of Diaphragm Spring

The diaphragm spring could be a steel disc having a hole at the middle, and therefore the inner portion of the disc is radially slotted in order that variety of causative (release-lever) fingers are formed. The outer ends of the slots square measure given enlarged blunting holes, that distribute the focused stresses created throughout deflection of the fingers, and additionally offer a way of locating the body part rivets, that restrain the pin rings. Unloaded, it is a dished shape. As the pressure plate cowl tightens, it pivots on its pin rings, and flattens dead set exert a force on the pressure plate, and also the facings. The transmission input shaft passes through the middle of the pressure plate. Its parallel splines interact with the interior splines of the central hub, on the friction disc. With engine rotation, the force will currently be transmitted from the regulator, through the friction disc, to the central hub, and to the transmission. When the foot lever is depressed, the movement is transferred through the in operation mechanism, to the in-operation fork and also the unleash bearing. The release bearing moves forward and pushes the middle of the diaphragm spring towards the regulator. The diaphragm pivots on its pin ring inflicting the environs to manoeuvre within the wrong way and act on the pressure-plate retraction clips. The pressure plate disengages, and drive is not any longer transmitted. Releasing the pedal permits the diaphragm to re-apply its clamping force and have interaction the clutch, and drive is renovated.



III. Clamp Load Calculation

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The axial force needed for transmission the torsion is thought because of the Clamp load. An estimation of the axial force may be computed by means that of the subsequent analytical approach. Considering associate degree annulate surface for the friction disk with inner radius Rhode Island and external radius r0, the axial force F and also the transmitted torsion T may be computed as a function of the traditional pressure p on the disk. The hypothesis of constant pressure is typically valid for brand spanking new clutches, whereas the hypothesis of constant wear is valid for worn clutches. Under the hypothesis of constant pressure, the axial force may be computed as

F = 3T
2 2
o i (1)
2kμ (r3 −r3)
o i

Where, μ being the friction constant, k the number of disk surfaces (k=2 for a clutch with only one disk). With similar symbols and beneath the hypothesis of constant wear, the axial force may be computed as

F = T 2 (2)
kμ ro+ri

By applying relative atomic mass.1 and eq.2, the axial force required to transmit the torsion may be computed.

Clamp Load calculation, By uniform pressure theory

2 R3 −R3
3 R2 −R2
2 1403−853
3 [1403−852]
o i
=114.7407 mm

2) Slip-Torque = 2μWRmean

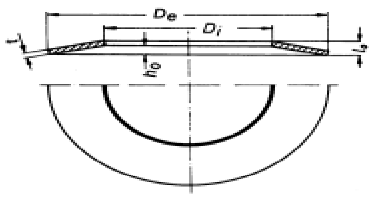
320 = 2 × 0.27 × w × 112.72/9.81

w = 526 kg

Actual w = FOS × 526

IV. Design Of Diaphragm Spring

A single diaphragm spring within the diaphragm spring clutch cowl replaces a large number of parts from its immediate forerunner, the spring and lever-type clutch cowl. This reduced complexness offers the diaphragm spring clutch a price, producing and weight advantage over previous varieties. Also the diaphragm spring’s characteristic, shallow conoid and high hundreds generated through little displacements change a compact package with high force transmittal capabilities. In the automotive clutch application, the Belleville spring is fancied with cantilever levers extending radially inward from the within diameter. This configuration is known as a diaphragm spring.



De = Outside diameter, metric linear unit Di = within diameter, mm
t = Thickness of individual spring, mm
ho = Free cone height of the blank individual spring, metric linear unit lo = Overall height of the individual spring, mm
lo = ho + t
F = Spring force, N
s = Deflection, mm
1) Diametric Ratio (δ) = Da = 263
=1.2208
3) Ln (δ) = 0.1995011
Dactual
215.427.
4) Load at flat condition, Pflat
= hS3 = 804.71355089 kgF
αDa
5) Load at flat with fulcrum, Pful = Pflat × ($a{-}Di$) = 933.6046175 kgF
Daf−Dif
6) Stress Calculations
2× 1
(δ−1) π
K1 = δ = 0.3133
δ+1 2
(− ( ))
δ−1 ln δ
K2 = 1 × 6 ×[(δ−1) – 1] = 1.0026
π ln(δ) ln(δ)
K3 =1 × σ × (δ−1) = 1.0551
π ln(δ) 2

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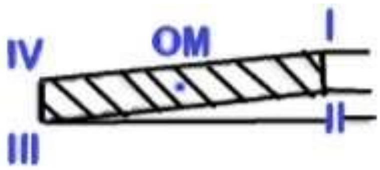

Fig. 1: Cross-Section of Diaphragm Spring

Stress at point OM

σ = −3 4E St

OM π (1− μ2) K1 D2

Stress at Point *'I'*

σ OM= −93.4483641 kgf/mm2

σ = −4E St h s

I (1− μ2) K1

D2 [K2 (t − 0.5 × t) + K3]

Stress at Point. *'II'*

σ I=−130.63kg/mm2

.σ = −4E St h s

II (1− μ2) K1

D2 [K2 (t − 0.5 × t) + K3]

Stress at point ‘*III'*

σ = −4E

σ II=−130.63kg/mm2

St h s

III

(1− μ2) δK1

ΔD2 [(2K3−K2) (t − 0.5 × t) + K3]

Stress at Point ‘IV’

σ III = 130.61kg/mm2

σ = −4E

St [(2K −K) h s

IV (1− μ2) δK1 2

3 2 (t − 0.5 × t) − K3]

Safe stress=80% of UTS.

σ IV = −12.31kg/mm2

i.e. 80% of 170 = 136 kg/mm2. All stress values ar inside limit thus style is safe.

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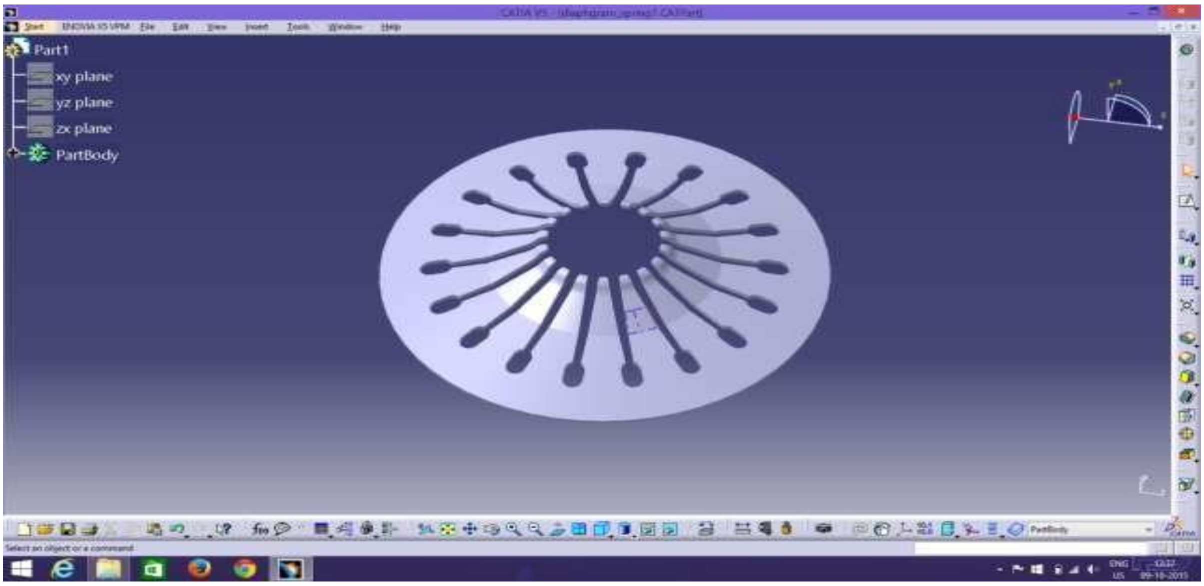


Fig. 2: Model of Diaphragm Spring

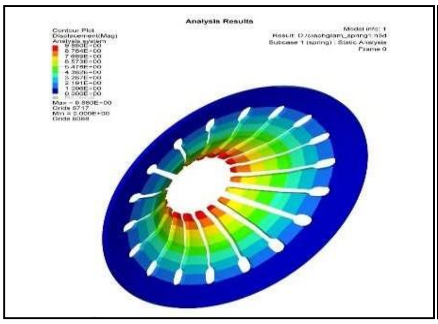
V. Finite Element Analysis of Diaphragm Spring

In this work, a straightforward structural analysis has been finished the designed diaphragm spring model. Results are valid too, in theory, calculate the deflection, principal stresses on the Inner and Outer surfaces that are iatrogenic within the spring.

Outer Diameter of Belleville Spring is one hundred forty millimetre and height of the spring is as five.670 mm. The analysis is finished by imposing boundary conditions such the spring may deflect solely on a different plane.

Constraints and Loading Conditions:

Where K1, K2 and K3 are constraints, E= modulus of physical property (2*105 MPa) and µ1= poisons quantitative relation (0.3).The representative stress and deformation contours for principal stresses on the inner & outer surface beside the deflection ar shown in figure three and four.



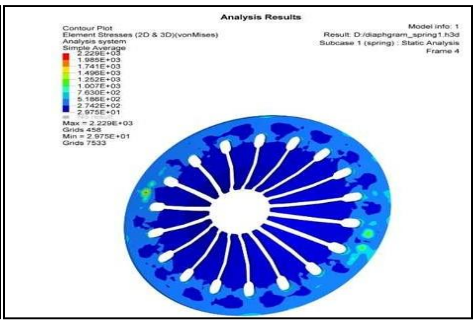


Fig. 3: Stress Analysis Fig. 4: Displacement Analysis

From theoretical calculations stress at purpose OM is ninety-three.4483641 kgf/mm2 and from Hypermesh result's 107 kgf/mm2.

Both the worths of stress area unit among ten you look after tolerance and stress results from code and theoretical each area unit underneath the UTS value of the spring material and thence design is safe in stress analysis.

Height of the spring is five.6723 millimetre and here most deflection of the spring ineffective space from wherever clamp load is applied (yellow region) is vi.573mm, each the values are among 100 per cent of tolerance and thence on paper calculated height is accepted and minor deflection on the far side the limit (height of spring) is accepted as spring is elastic body and here it is used for applying load therefore exceptional worth doesn't have an effect on the operating of spring.

VI. Conclusion

Thus, it's complete that the analytical equations for Belleville springs tho' estimate the utmost stresses and deflection certainly case, however finite component analysis is usually recommended for correct estimation of most stress and deflection just in case of Belleville spring underneath given loading condition. Design of spring is safe in stress and deflection analysis underneath the loading conditions.

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