DESIGN OF A POWER TRANSMISSION DEVICE FOR A COMPRESSOR

by :

Michalakis Savva

Project Report
Submitted to
the Department of Mechanical Engineering
of the Higher Technical Institute
Nicosia - Cyprus

in partial fulfillment of the requirements
for the diploma of
TECHNICIAN ENGINEER

in

MECHANICAL ENGINEERING

JUNE, 1990

HIGHER TECHNICAL INSTITUTE
ACCESSION NO
1692

ABSTRACT

The aim of this project is to design a power transmission device for a compressor, with proper selection of materials and components required, all necessary drawings and a cost estimation.

The project is divided into seven chapters each one being fully explained in the foregoing contents.

Chapter 1 deals with the selection of the type of drive suitable for this project.

Chapter 2 deals with the design of the selected drive.

Chapter 3 deals with the design of the compressor shaft.

Chapter 4 deals with the design of keys and keyways involved in this project.

Chapter 5 deals with the design of the supporting system for the prime mover.

Chapter 6 deals with the design of a tensioning system for the belts involved.

Chapter 7 gives a precise estimation of the costs involved in the construction of the device.

CONTENTS

Pages

ABSTRACT vi

CHAPTER 1 : INTRODUCTION TO POWER TRANSMISSION

1.1 Introduction to power transmission devices 1
1.1.1 Belt drives 1
1.1.2 Chain drives 2
1.1.3 Gear drives 3
1.2 Selection of drive 3
1.3 Types of belt drives 4
1.3.1 Flat belts 4
1.3.2 V-belts 5
1.3.3 Link V-belts 6
1.3.4 Timing belts 6
1.4 Selection of belt type 7

CHAPTER 2 : SELECTION OF V BELT DRIVE

2.1 Selection of the driving motor 8
2.2 Selection of the V-belt drive 8
2.2.1 Service factor 9
2.2.2 Design power 9
2.2.3 Belt section 9
2.2.4 Speed ratio 9
2.2.5 Motor pulley limitation 10
2.2.6 Pulley pitch diameters 10
2.2.7 Centre distance 10
2.2.8 Basic power per belt 11
2.2.9 Speed ratio increment 12
2.2.10 Belt length correction factor 12
2.2.11 Arc of contact correction factor 13
2.2.12 Corrected power per belt 13
2.2.13 Number of belts required 13
2.3 Drive specification 13

Page

CHAPTER 3 : DESIGN OF THE COMPRESSOR SHAFT

3.1 Design of the compressor shaft 15
3.2 Conditions for validity of the analysis to be followed 15
3.3 Determination of ratio of tensions for a V-belt 15
3.4 Calculation of tensioning forces for a single belt 17
3.5 Calculation of forces acting on the compressor shaft 19
3.6 Shaft length 20
3.7 Torsional moment on the compressor shaft 21
3.8 Bending moment on the compressor shaft 21
3.9 Selection of shaft material 22
3.10 Factor of safety 22
3.11 Determination of shaft diameter 22
3.11.1 Design using maximum shear stress theorem ... 24
3.11.2 Design using ASME code 24
3.11.3 Design using Soderberg Approach 26
3.12 Selection of shaft diameter 27

CHAPTER 4 : DESIGN OF KEYS AND KEYWAYS

4.1 Keys and Keyways 28
4.2 Selection of material for keys 28
4.3 Design of compressor key 29
4.3.1 Check for shear failure of key 30
4.3.2 Check for failure due to crashing 31
4.3.3 Selection of key length 32
4.4 Motor key and keyway 32

CHAPTER 5 : MOTOR SUPPORTING

5.1 Motor supporting 33
5.2 Selection of Π-section beams 34
5.3 Selection of motor bolts 34
5.4 Design of beam bolts 36

Pages

5.4.1 Forces acting on beam bolts 37
5.4.2 Selection of beam bolts material 38
5.4.3 Shear force and bending moment diagrams 38
5.4.4 Check of beam bolts for shear failure 39
5.4.5 Check of beam bolts for bearing failure 39
5.4.6 Check of beam bolts for bending failure 39
5.4.7 Length of beam bolts and selection of nut ... 40

CHAPTER 6 : TENSIONING SYSTEM
6.1 Tensioning system 41
6.2 Design of power screw 42
6.2.1 Compression load on power screw 42
6.2.2 Check of power screw for compression failure. 43
6.3 Nut design 44
6.3.1 Check of screw threads for shear failure 44
6.3.2 Check of nut threads for shear failure 44
6.3.3 Check of threads for bearing failure 45
6.3.4 Nut selection 45
6.4 Design of bolts securing the nuts 46
6.4.1 Check of bolts for shear failure 47
6.4.2 Check of bolts for bearing failure 47
6.4.3 Nut Selection 48

CHAPTER 7 : COST ANALYSIS
7.1 Cost analysis 49

CONCLUSIONS 50

REFERENCES

APPENDIX

DRAWINGS