CLUTCH
A PROGRAM FOR THE SIMULATION
OF CLUTCH THERMAL BEHAVIOUR

CRANKSHAFT
RELEASE BEARING
DRIVETRAIN INPUT SHAFT
REVOLUTION AXIS
DIAPHRAGM SPRING
FLYWHEEL
PRESSURE PLATE
CLUTCH COVER
FRICTION FACINGS
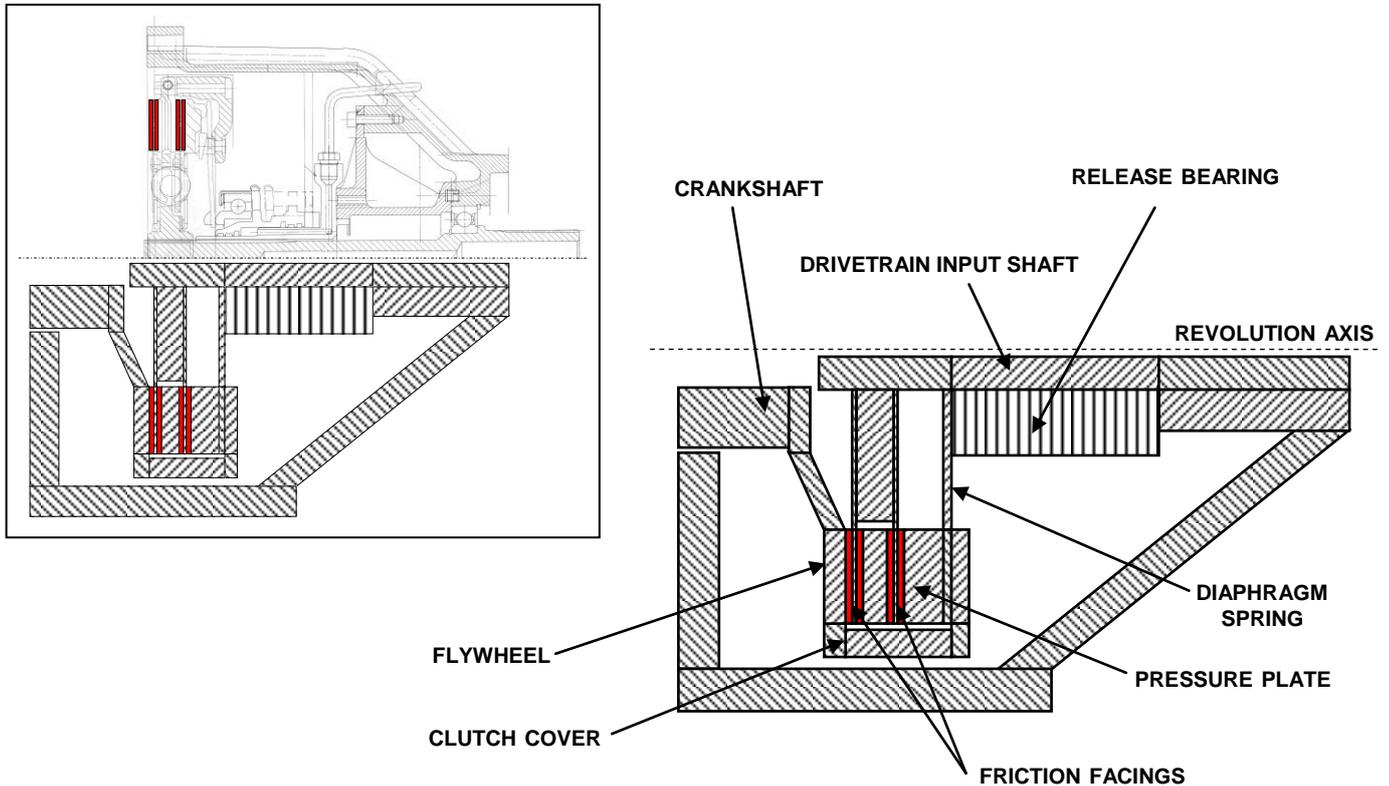
OVERVIEW

CLUTCH is an applicative software, developed in the MATLAB/SIMULINK™ environment that evaluates the main clutch elements temperature from experimental or calculated thermal power input. In particular **CLUTCH** allows visualizing the calculated temperatures of flywheel, friction disks, facings, thrust disk and clutch box and the heat quantities exchanged between the elements and the box internal air. Each temperature variable can be correspondent, for example, to temperature sensors used during tests in order to be compared with experimental values. The results of simulation can be re-sampled according to a time range chosen by the user.

PROGRAM DESCRIPTION

CLUTCH runs under the MathWorks MATLAB/SIMULINK® environment: a very powerful, qualified mathematical solver and systems simulation tool. The **CLUTCH** program includes user-friendly graphic interface based on buttons and menu driven commands, which only require knowledge of basic pc use.

This software tool is able to evaluate the thermal cycle of a clutch system through the calculation and visualization of temperatures and heat flows, thus helping in the prediction of the durability of the clutch itself.

The clutch system is considered as an assembly of annular shape elements exchanging heat with each other and with the air inside and outside the clutch housing.

The thermal power input data are obtained from the instrumentation placed on the vehicle during tests or can be the results of calculation, for example using **DRIVE**[1] The simulation results can be visualized, for every element and for the clutch box internal air, through temperature and exchanged heat plots, given as functions of time.

The calculated values can be saved and recorded in order to be examined later, or compared with previous simulations.

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[1] **DRIVE** is another applicative software by S.A.T.E. S.r.l. for drivetrain simulation

PROCEDURES OUTLINE

The user defines the parameters of the simulation in easily editable and pre-formatted MS Excel® files, which can be stored to create a library of data sets that may be recalled for further simulations. Data include:

- relevant dimensions;
- input signals, i.e. vehicle velocity, engine speed and power input;
- temperatures of boundary elements;
- conduction factors;
- radiation factors;
- convection constants;
- materials characteristics.

Results of the simulation, illustrated as time histories of the calculated variables, are displayed in a variety of output plots that can be printed or exported to other environments. Numerical results can also be written in files compatible and already formatted for easy handling by spreadsheets such as MS Excel®.

SIMULATION SERVICES

CLUTCH is also used as a tool for engineering services that S.A.T.E. provides customers not wishing to enter the functions and details of the program. In this case the results of the simulations are produced as reports, together with comments and guidelines for system modifications.

VALIDATION

CLUTCH was tested and validated with theoretical solutions, delivered also as test examples to allow both qualification of the procedure and practising, and on comparison with existing machines.

CLUTCH
Frict. Power (W)

Power input data

CLUTCH
temp. of all elements (°C)

Temp. results
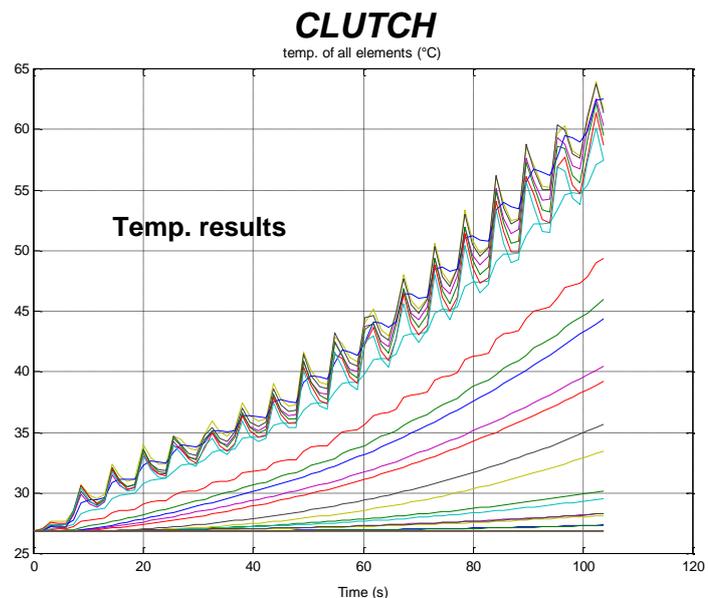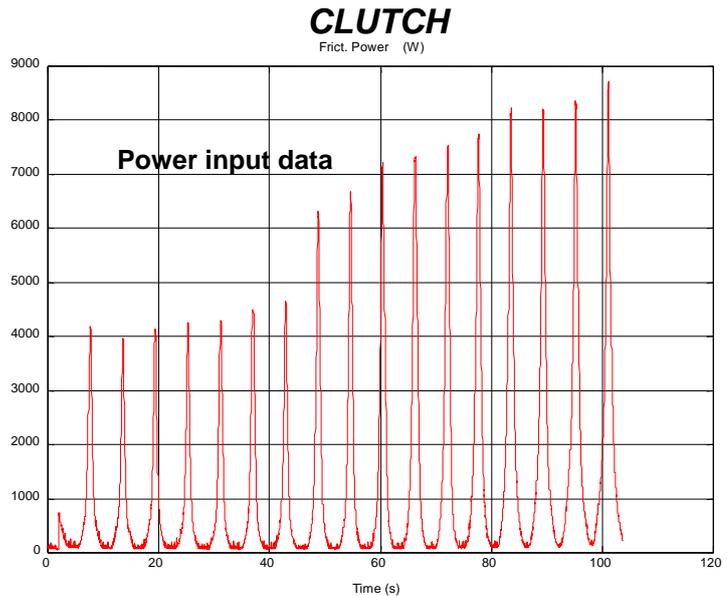
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