AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
DEPT. OF ENERGY & AUTOMOTIVE ENGINEERING

"ANALYSIS OF FORCES DUE TO ROLLING OF A LOADED TIRE OVER AN OBSTACLE"

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BY Mahmoud

NAGLA MARZOUK KANDIL
(B.Sc. Mech. Eng. 1975)
Ain Shams University

SUPERVISED BY:

Dr. T.A. MOSSEIR — Assistant Professor
Prof.Dr. M.M. EL ALAILY — Professor of Automotive Eng.

CAIRO, 1984

Examiners

Prof. Dr. M.A. MORSY
Consultant in Arab Organization for
Industralization.

Dr. F.A. TOLBA
Asst. Professor in Design and
Production Dept.

Prof. Dr. M.M. EL ALAILY (Supervisor)
Prof. of Automotive Engineering

Dr. T.A. NOSSEIR
Asst. Professor in Energy and
Automotive Dept.

بسم الله الرحمن الرحيم

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C O N T E N T

Page

Page

NOTATION

$a_1, a_2, \ldots a_n$	Denominator coefficients of the transfer function.	
b	Obstacle width	mm
$b_1, b_2, \ldots b_m$	Numinator coefficients of the transfer function.	
c	Damping coefficient	N.S/m
d	Attack distance	mm
D(w)	Spectral content of the road irregularities (after reference 2)	
E(w)	Spectrum of the force response to a pulse of unit height (after reference 2)	
$f_1, f_2, \ldots f_n$	System of non-linear equations	
f(x)	Enveloping force (after ref. 1)	N
F_i	Tire preload calculated from the distribution curve.	N
F(x)	Vertical force.	N
$F^n(x)$	The n^{th} derivative of F(x)	
F(S)	Laplace transform of the vertical force	
G(h)	Function depending on the obstacle height	m^2

h	Obstacle height	mm
I	Impulse communicated to the tested tire.	N.S
J	Impulse communicated to the proposed elastic wheel.	N.S
K	Tire stiffness.	N/m
l	Length of contact (after reference 1)	mm
	Distance between the obstacle and the dynamometer	mm
L	Length of contact	mm
m	Mass	Kg
P_i	Inflation pressure	N/m^2
R	Wheel radius	mm
V	flywheel speed	m/s
W	Tire preload	N
$W(s)$	Transfer function	
x	Distance traveled by the obstacle	mm
$x_1, x_2 .. x_n$	Variables of non-linear equations	
y	Deflection of the proposed wheel due to passing over the obstacle	mm
α_o	Attack angle	radian
	Initial tire deflection	mm
$\phi(x)$	Road elevation (after reference 1)	
$\psi(x)$	Response to a step function	N
$\psi_c(w)$	Response to a step function computed	N

LIST OF FIGURES

Figure No.	Description
9	Couparison between vertical force response to square and trapezoidal obstacle having the same height (Ref. 3).
10	Tangential force response to a square obstacle at different tire deflection (Ref. 3).
11	General layout of the test rig.
12	Vertical and tangential strain gauges mounting.
13	Speed transducer.
14	Slip ring construction.
15	Dynamometer for measuring the vertical force distribution at the contact patch.
16-18	Photo of the test rig and the instrumentation.
19-20	Sample of the recorded signals.
21-23	Effect of obstacle height on the variation of the vertical force.
24-26	Effect of obstacle height on the tangential force.
27-28	Effect of obstacle width on the variation of the vertical force.
29	Effect of obstacle width on the tangential force.
30	Effect of inflation pressure on the variation of the vertical force.

LIST OF TABLES

A B S T R A C T

The present work was carried out to measure and analyse the vertical and tangential forces acting on the tire and arising due to its rolling over on obstacle under different working conditions. Also to determine the instantaneous force distribution at the contact zone in the case of the presence of an obstacle inside the contact zone. A test rig was built to accomplish the experimental work.

The enveloping forces acting on the tire are affected by the dimensions of the obstacle. They increase with the increase of the height and width of the obstacle, and the inflation pressure of the tire and with the decrease in the initial tire deflection. It was also found that the peak values of the enveloping forces are slightly affected by the change of the initial pre-load. The greatest part of the enveloping forces arises from the inflation pressure.

The enveloping capability of the tire "η" was defined. It relates the impulse energy communicated to the tested tire to that communicated to an elastic wheel having the same stiffness as the tested tire, under the different working conditions but without the