

SINGLE-CONVERTER REVERSE-TORQUE DRIVE

VOLUME II

(diagrams only)

by

STEWART GLENDINNING MCLAREN

Presented to the University of Cape Town
in fulfilment of the requirements for the

Degree of Doctor of Philosophy

December 1976

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SINGLE-CONVERTER REVERSE TORQUE DRIVE

VOLUME II:

(Diagrams Only)

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APPENDIX II : COMPUTER PROGRAMME MXF

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Fig. A.1 : Flow Chart for Programme MXF

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CHAPTER 2 : MOTOR CONFIGURATION

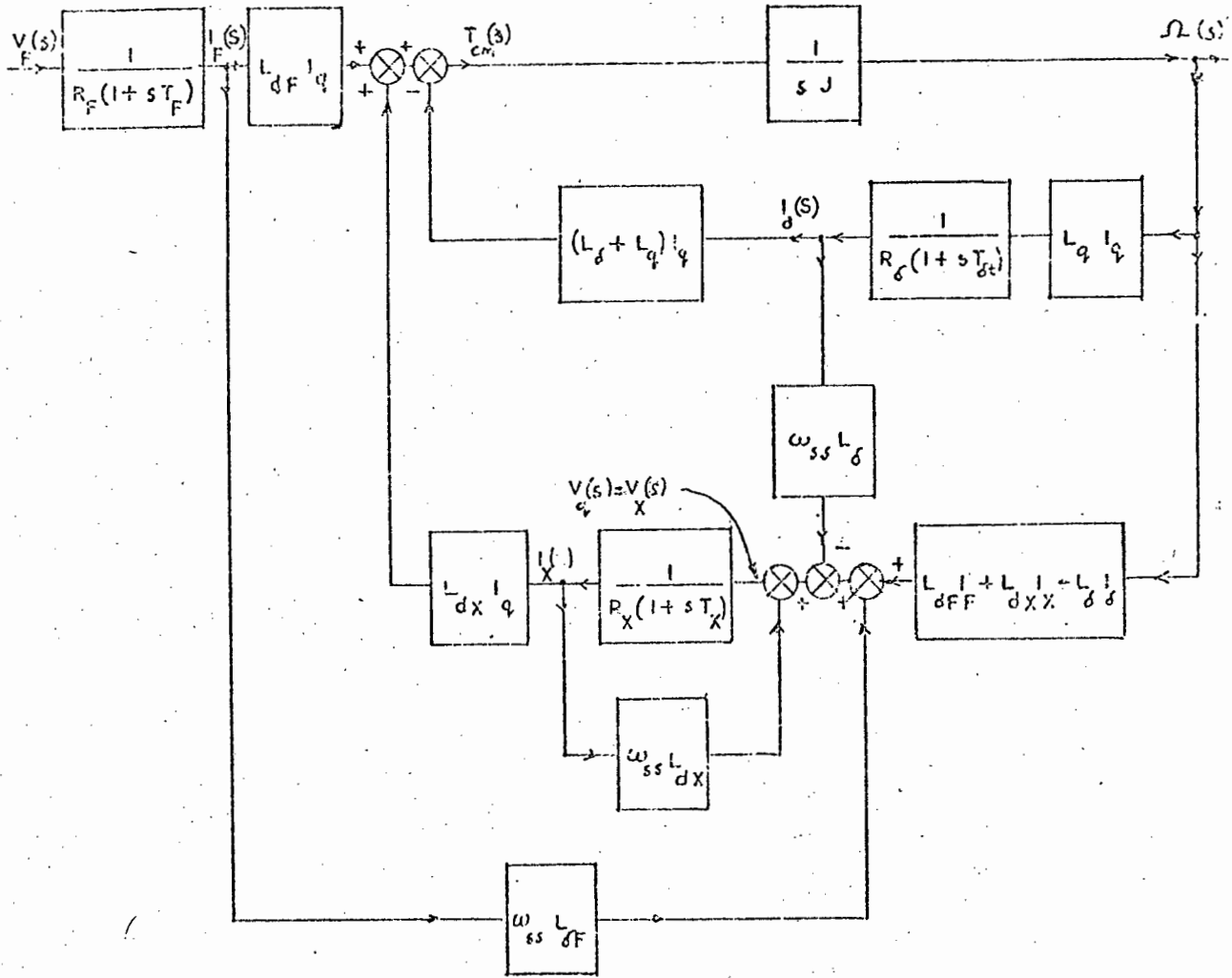


FIG 4.17 : PERTURBATION DIAGRAM : SPEED / FIELD VOLTAGE

WITH VOLTAGE FEEDBACK : WITHOUT TRANSFORMER COUPLING

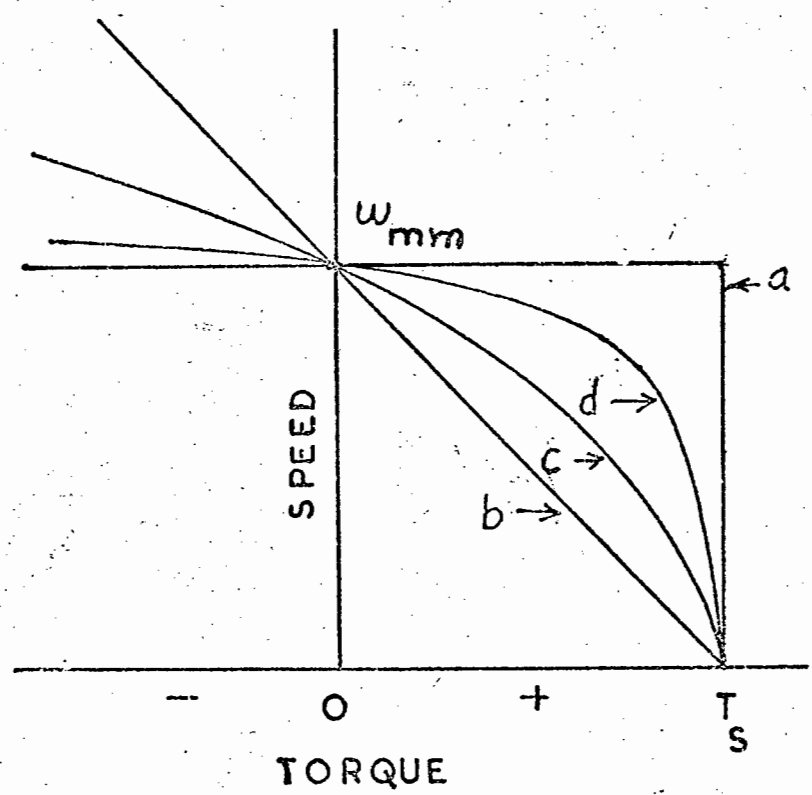
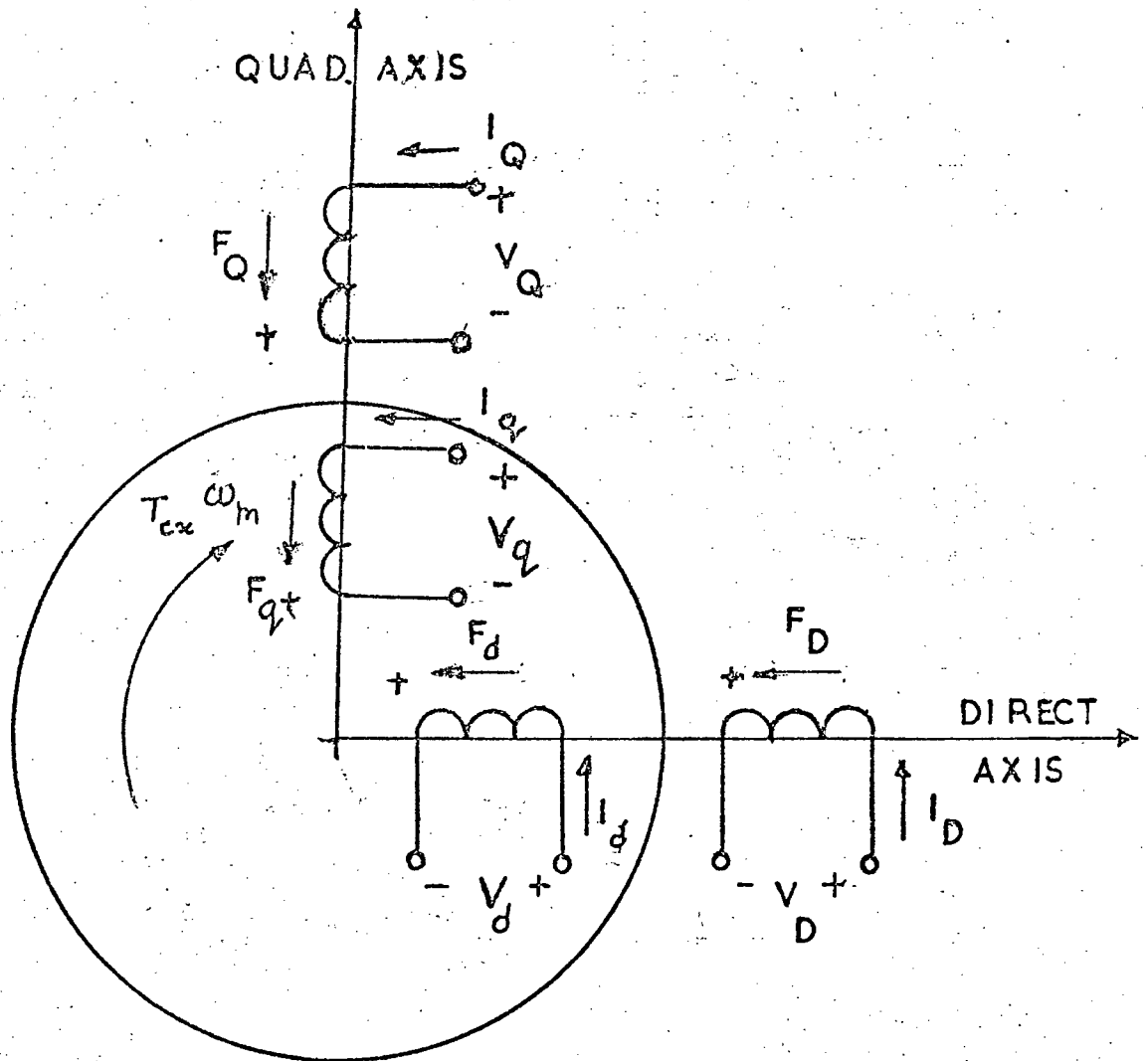


FIG 2.1 TORQUE / SPEED CHARACTERISTICS



$F = \text{M.M.F.}$

FIG. 2.2: GENERALISED MACHINE

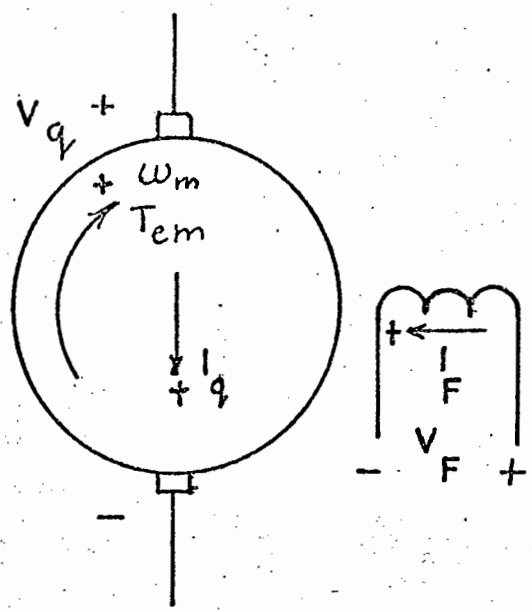


FIG 2.3 CONVENTIONAL D.C. MACHINE

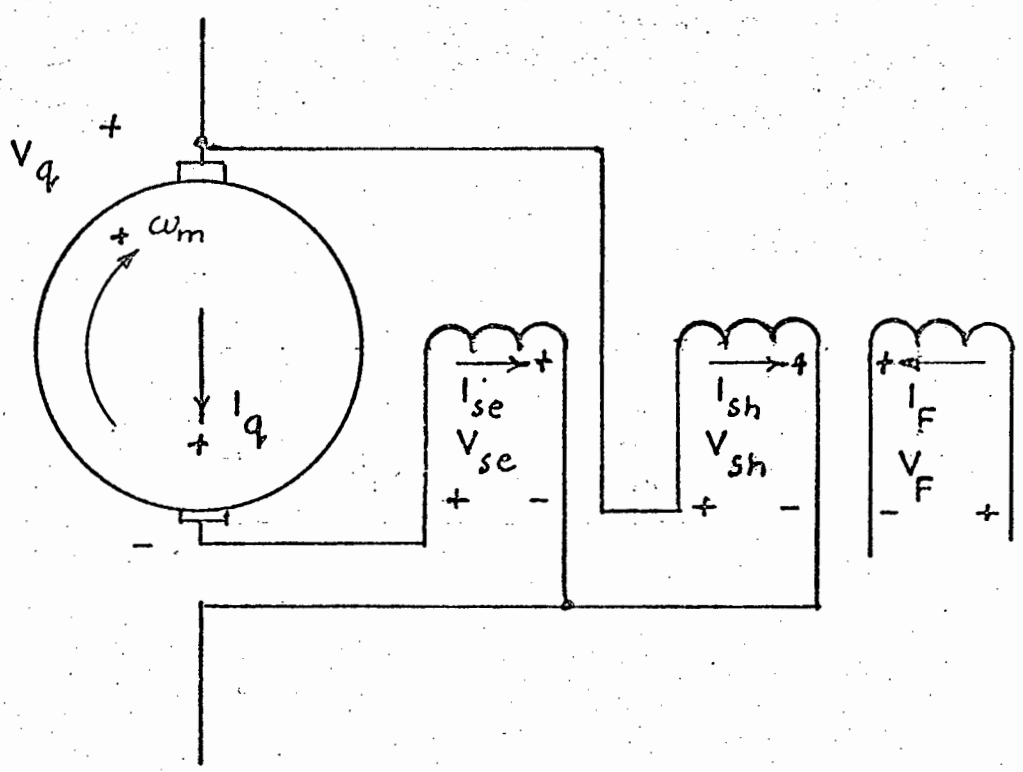


FIG 2.4 THREE-FIELD MACHINE

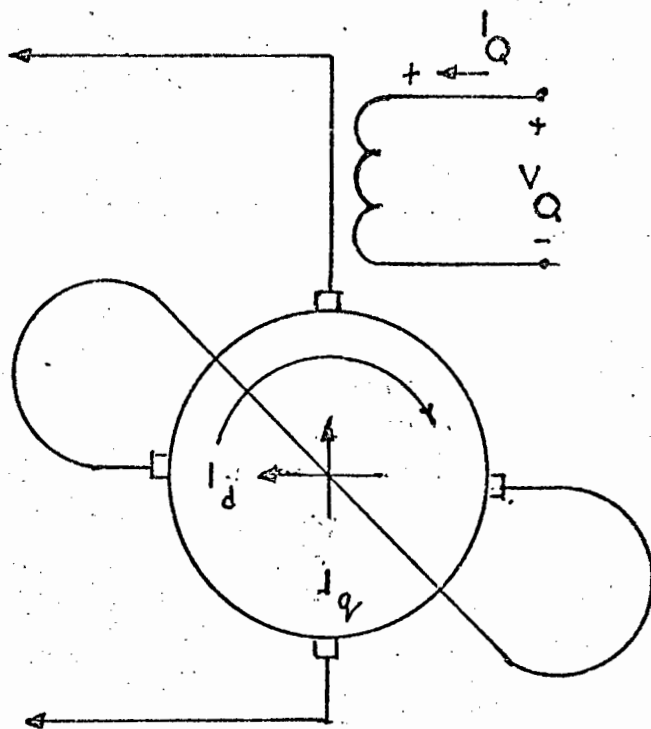


FIG. 2.5 UNCOMPENSATED CROSS-FIELD GENERATOR

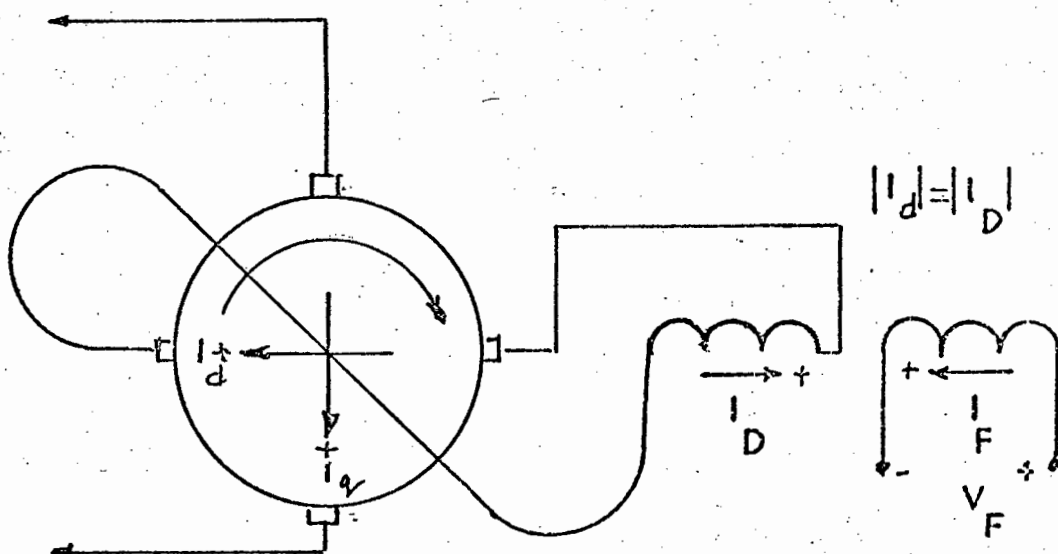


FIG. 2.6 CROSS-FIELD MOTOR

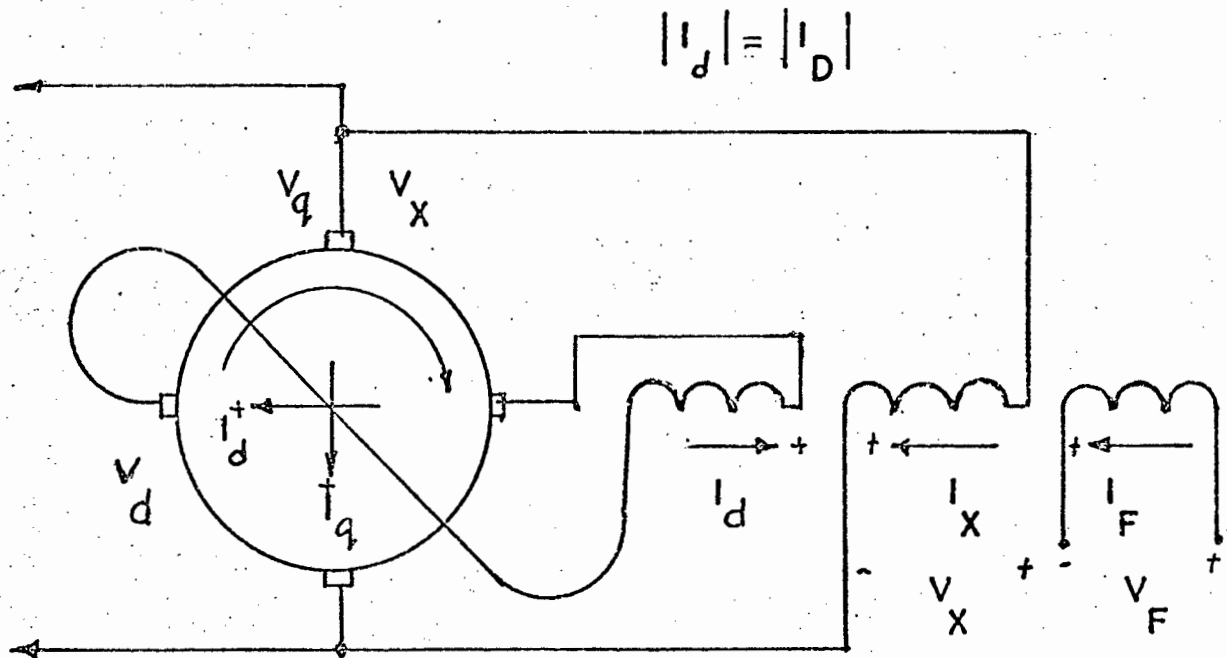


FIG 2.7 CROSS-FIELD MOTOR WITH VOLTAGE
FEEDBACK

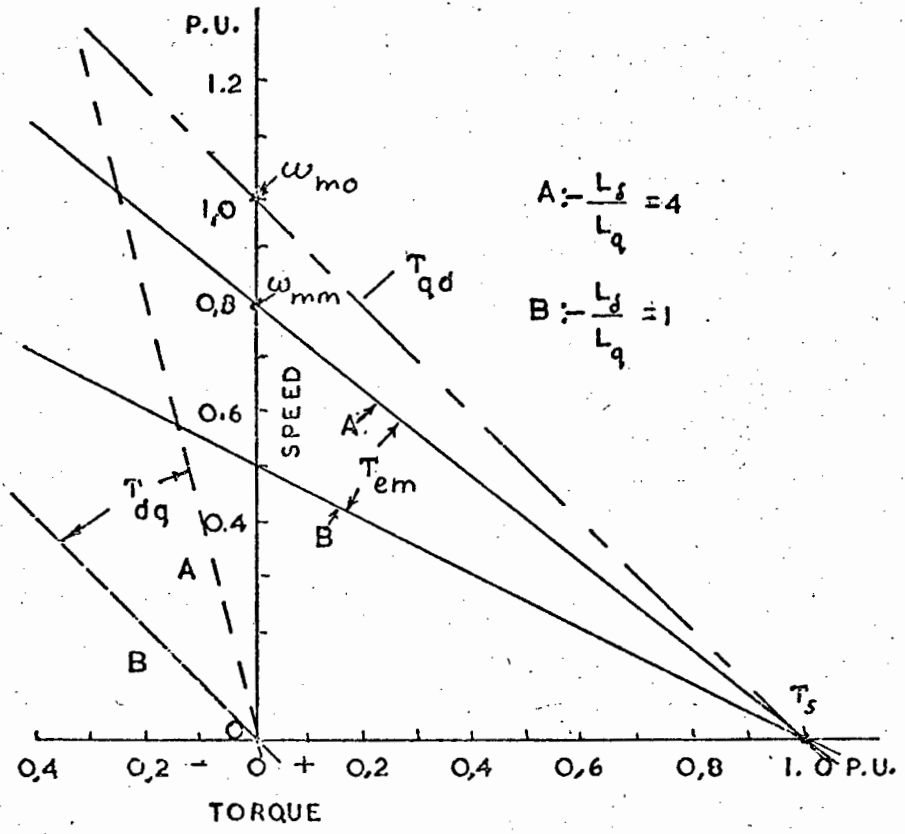


FIG 3.1 TORQUE/SPEED CHARACTERISTIC
OF THE CROSS-FIELD MOTOR

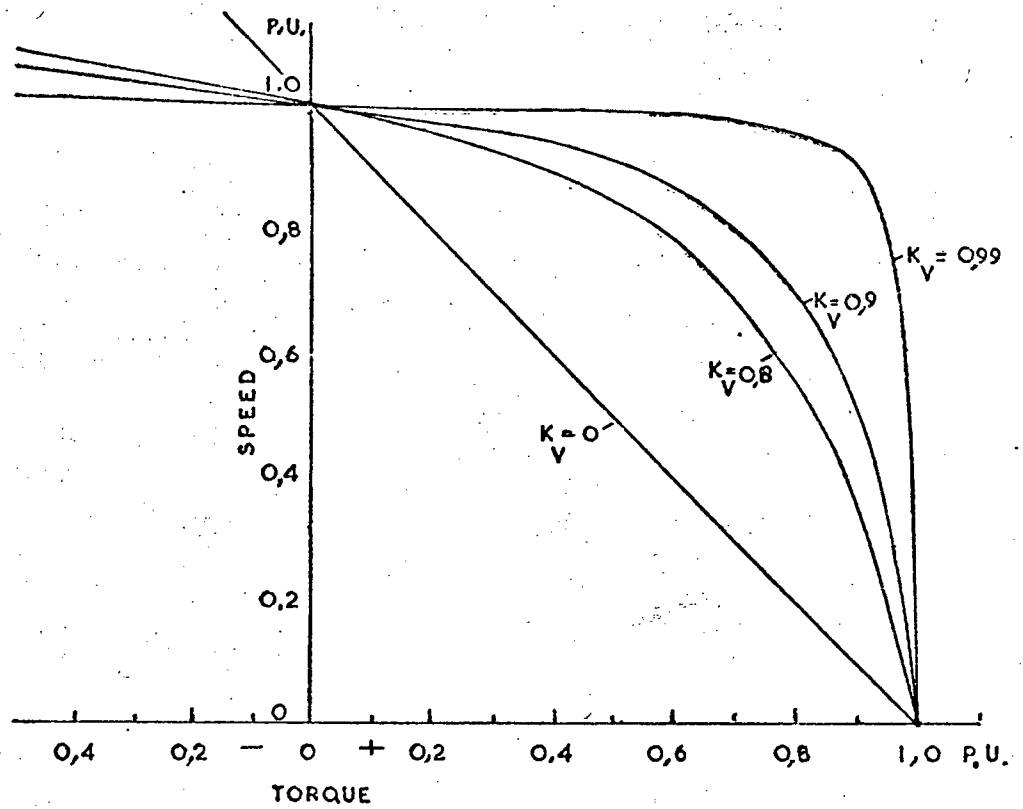


FIG 3.2 EFFECT OF VOLTAGE FEEDBACK ON DIRECT TORQUE

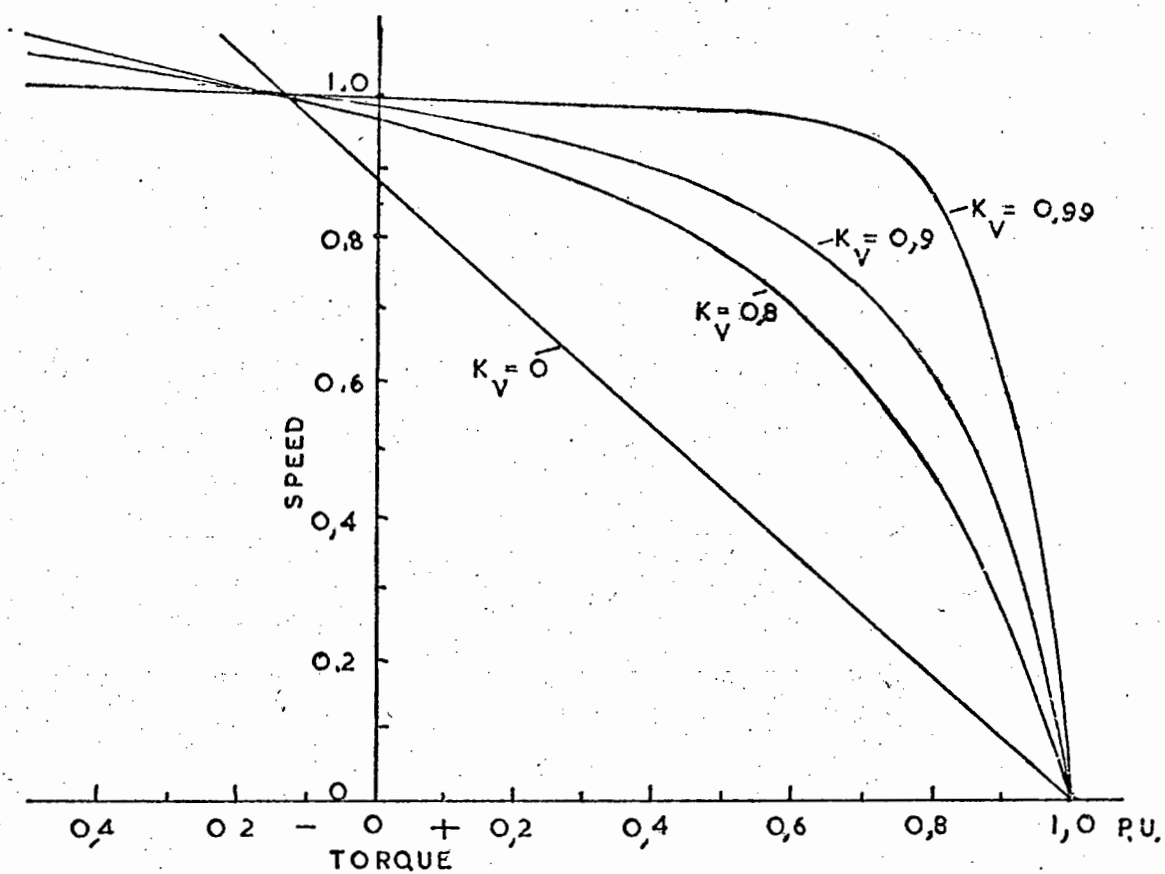


FIG 3.3 EFFECT OF VOLTAGE FEEDBACK ON ELECTRO-MAGNETIC TORQUE

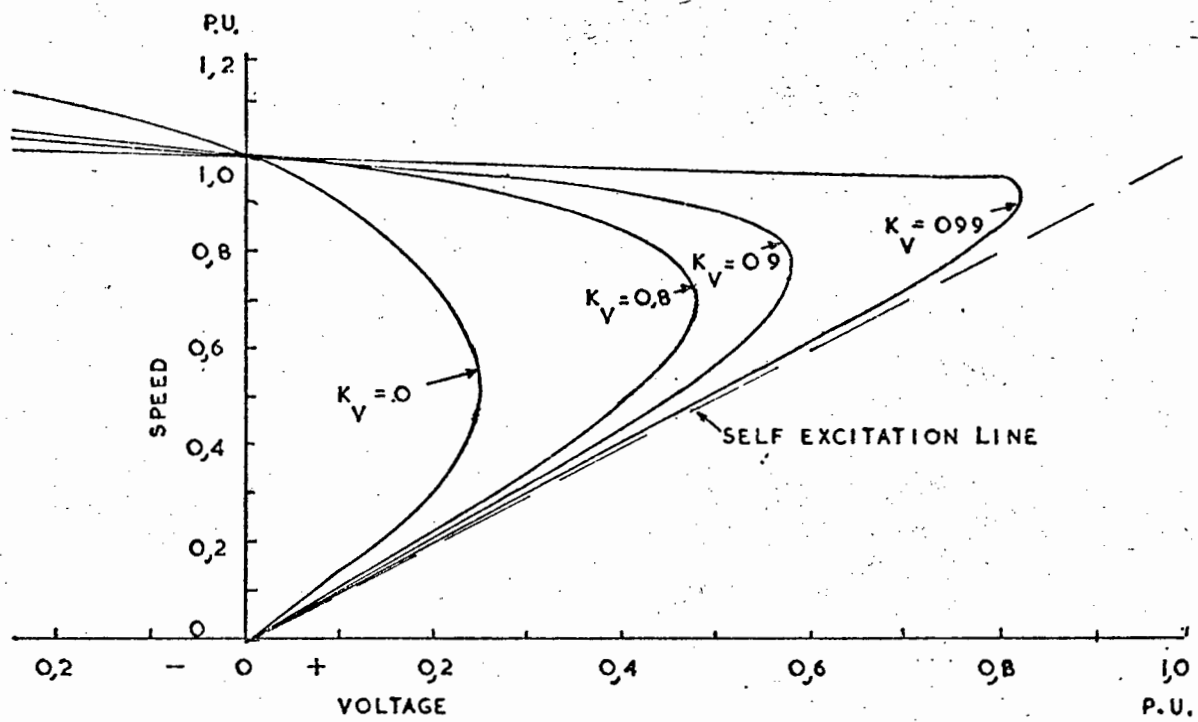
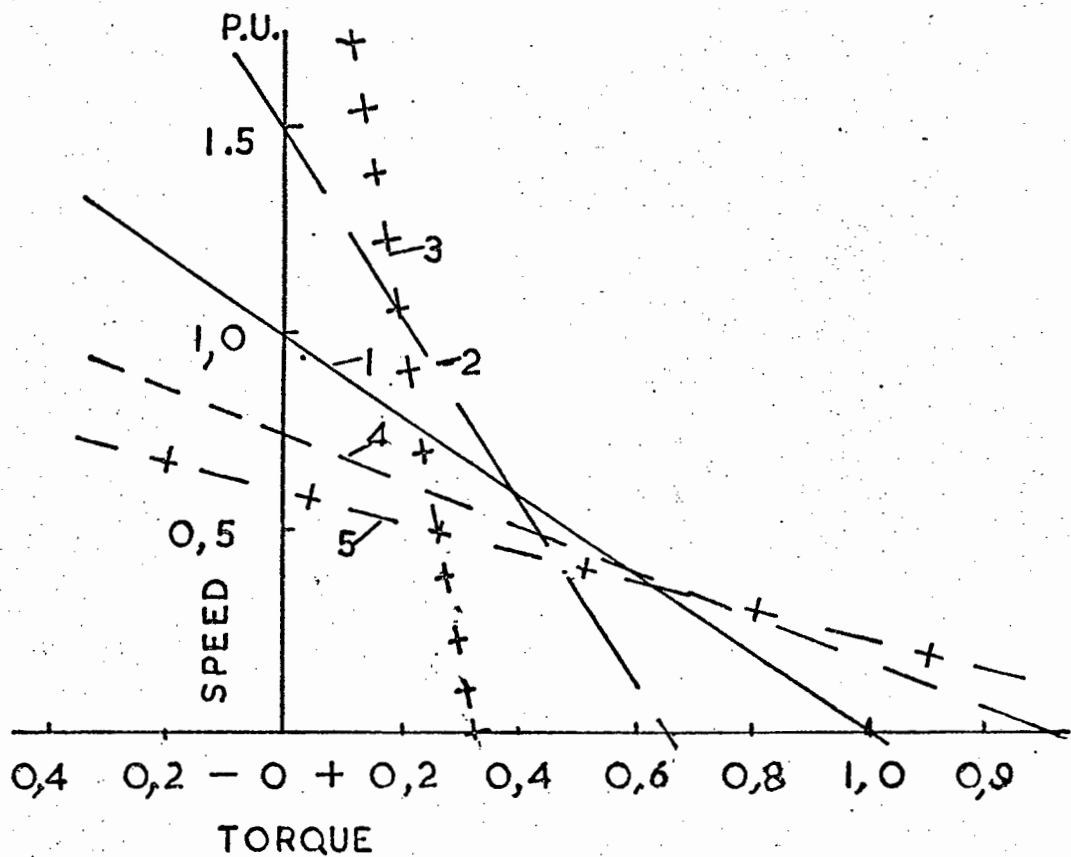


FIG 3.4 INPUT VOLTAGE/SPEED CHARACTERISTIC

WITH VOLTAGE FEEDBACK EFFECT



VALUE OF I_q :-

- 1 1.00 P.U. —————
- 2 0.66 P.U. - - - - -
- 3 0.33 P.U. + + + +
- 4 1.33 P.U. - - - - -
- 5 1.66 P.U. — + — +

FIG 3.5 EFFECT OF THE VARIATION OF
INPUT CURRENT I_q

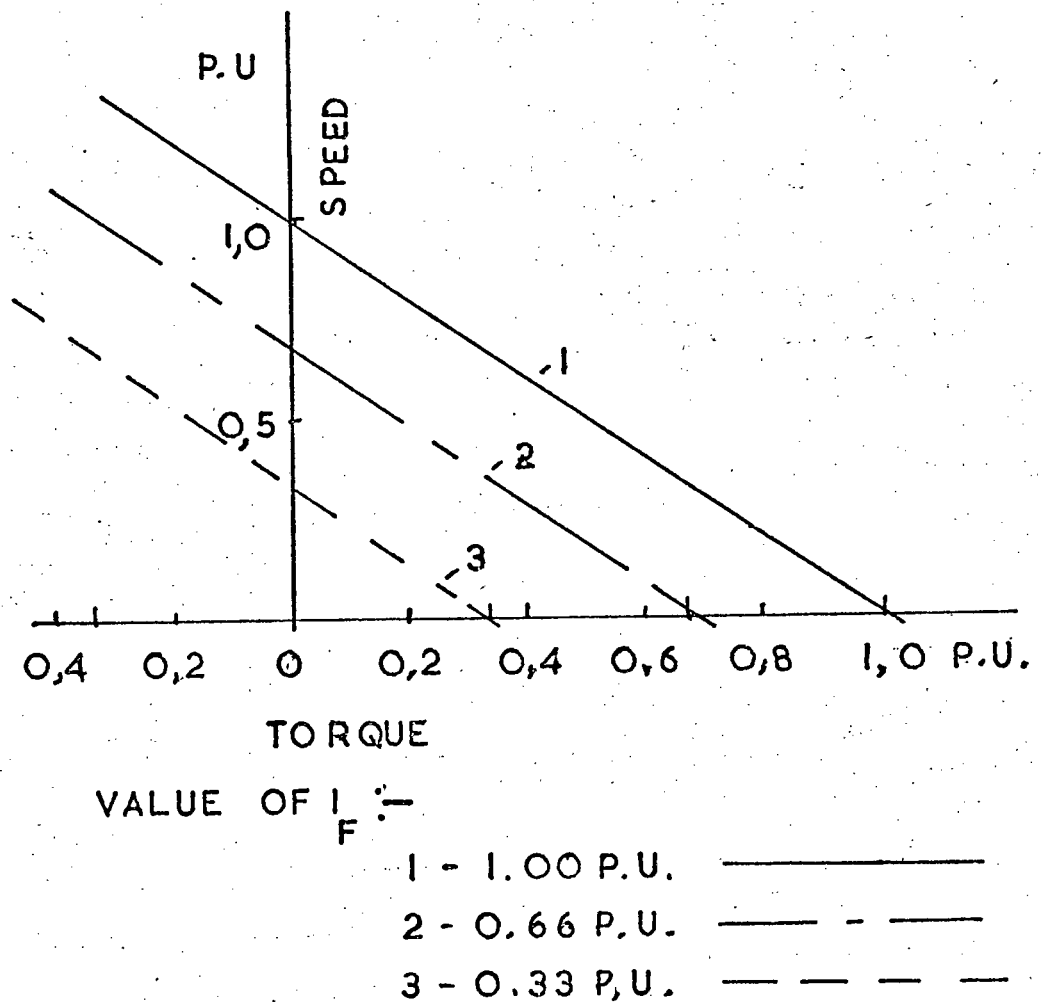


FIG 3.6 EFFECT OF VARIATION OF FIELD
CURRENT

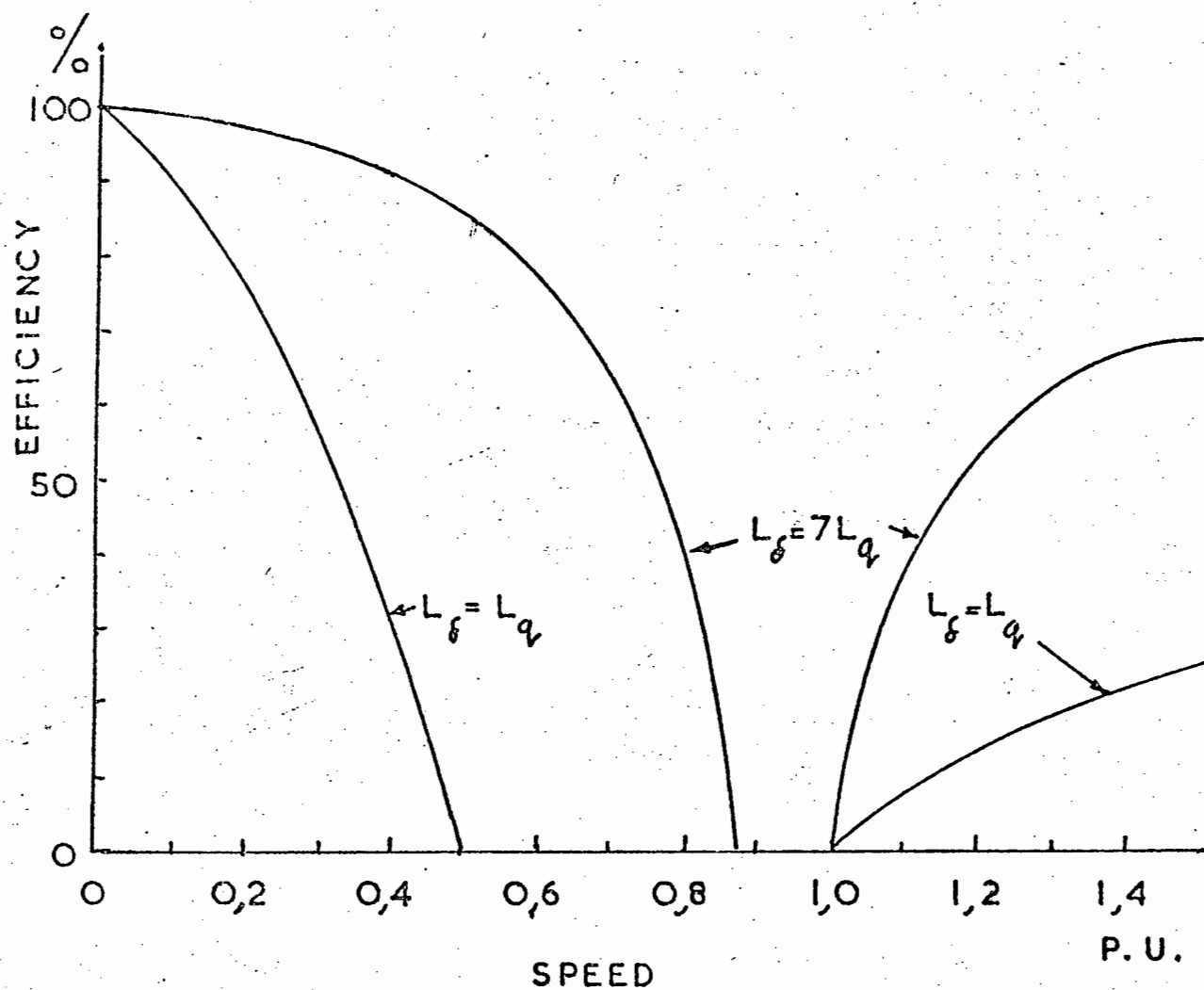
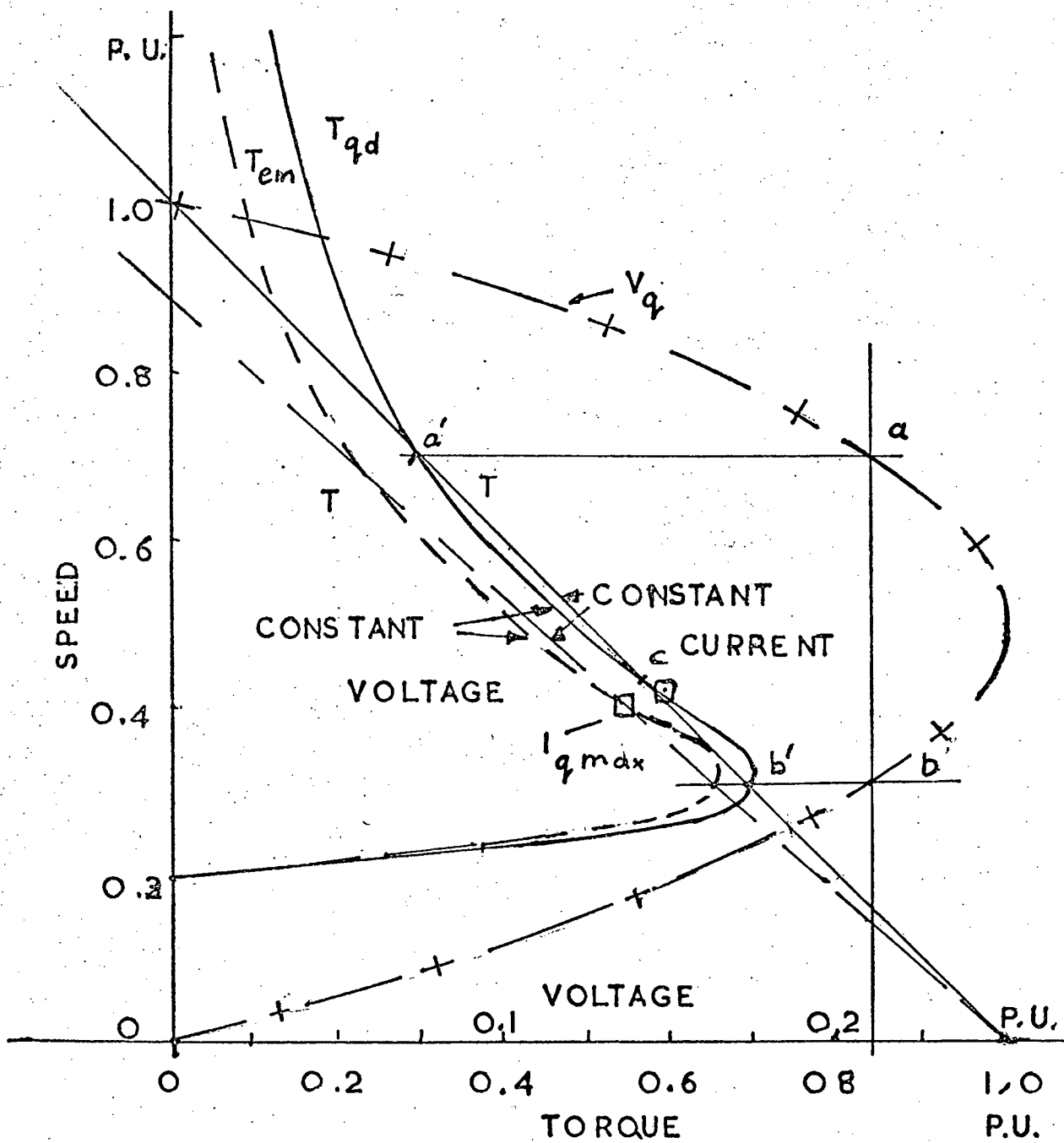


FIG 3.7 THEORETICAL EFFICIENCY OF CROSS-FIELD MOTOR



CONSTANT VOLTAGE —————
 CONSTANT CURRENT - - - - -
 VOLTAGE — + —

FIG 3.8. EFFECT OF VOLTAGE LIMITATION

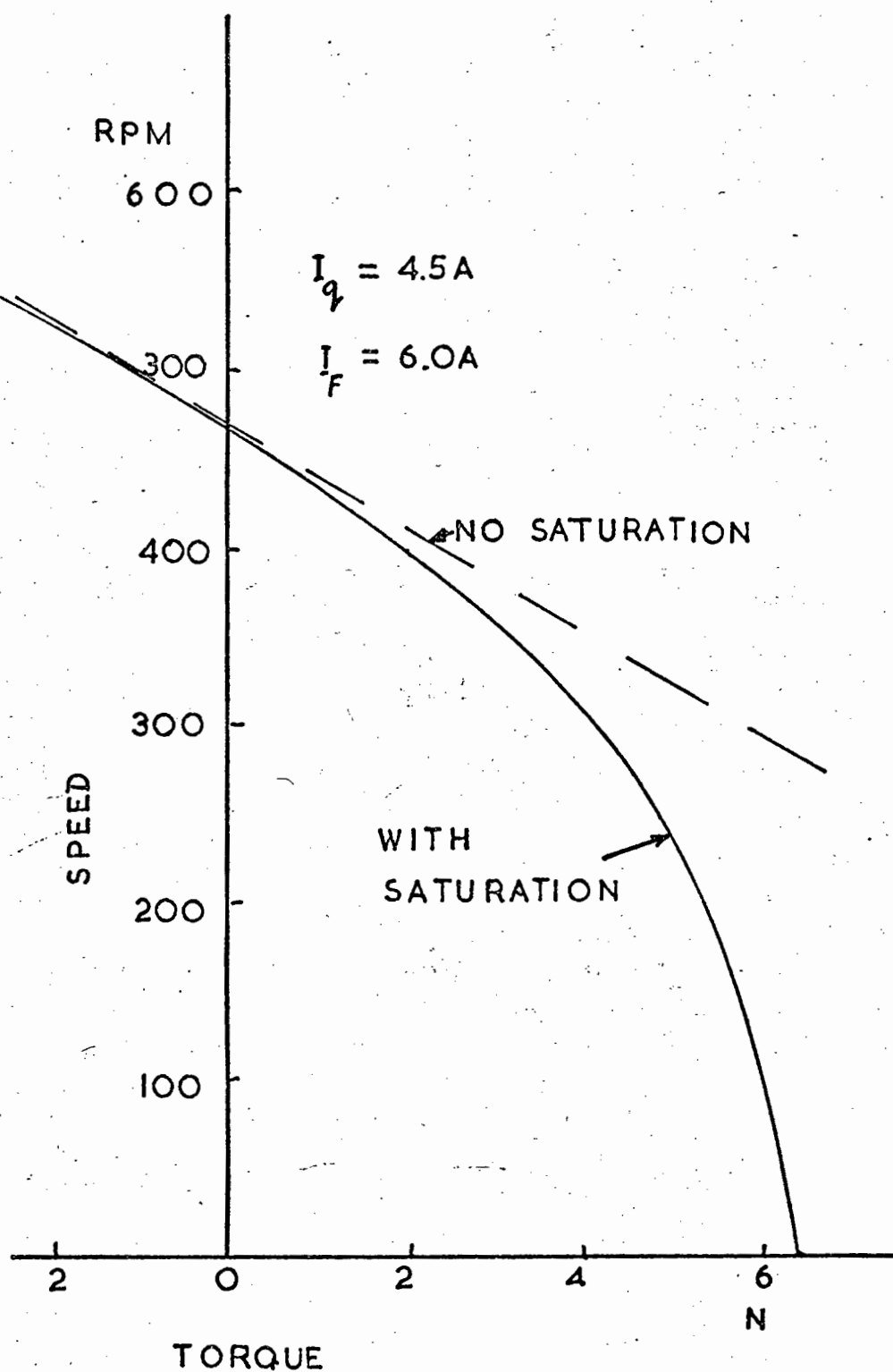


FIG 3.9 EFFECT OF SATURATION

NO VOLTAGE FEEDBACK

CHAPTER 4 : DYNAMIC PERFORMANCE OF THE CROSS-FIELD
MOTOR

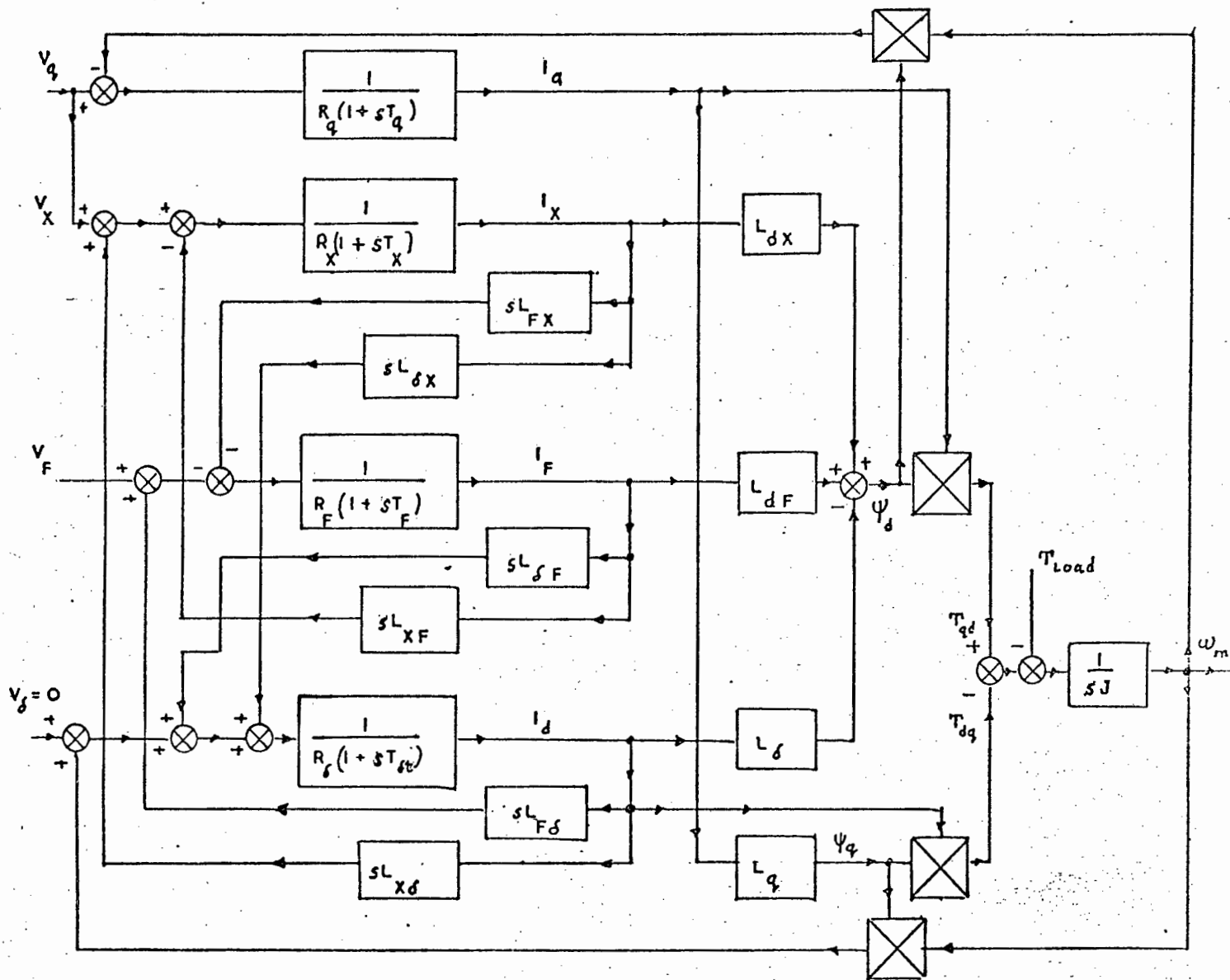


FIG 4.1 MOTOR BLOCK DIAGRAM

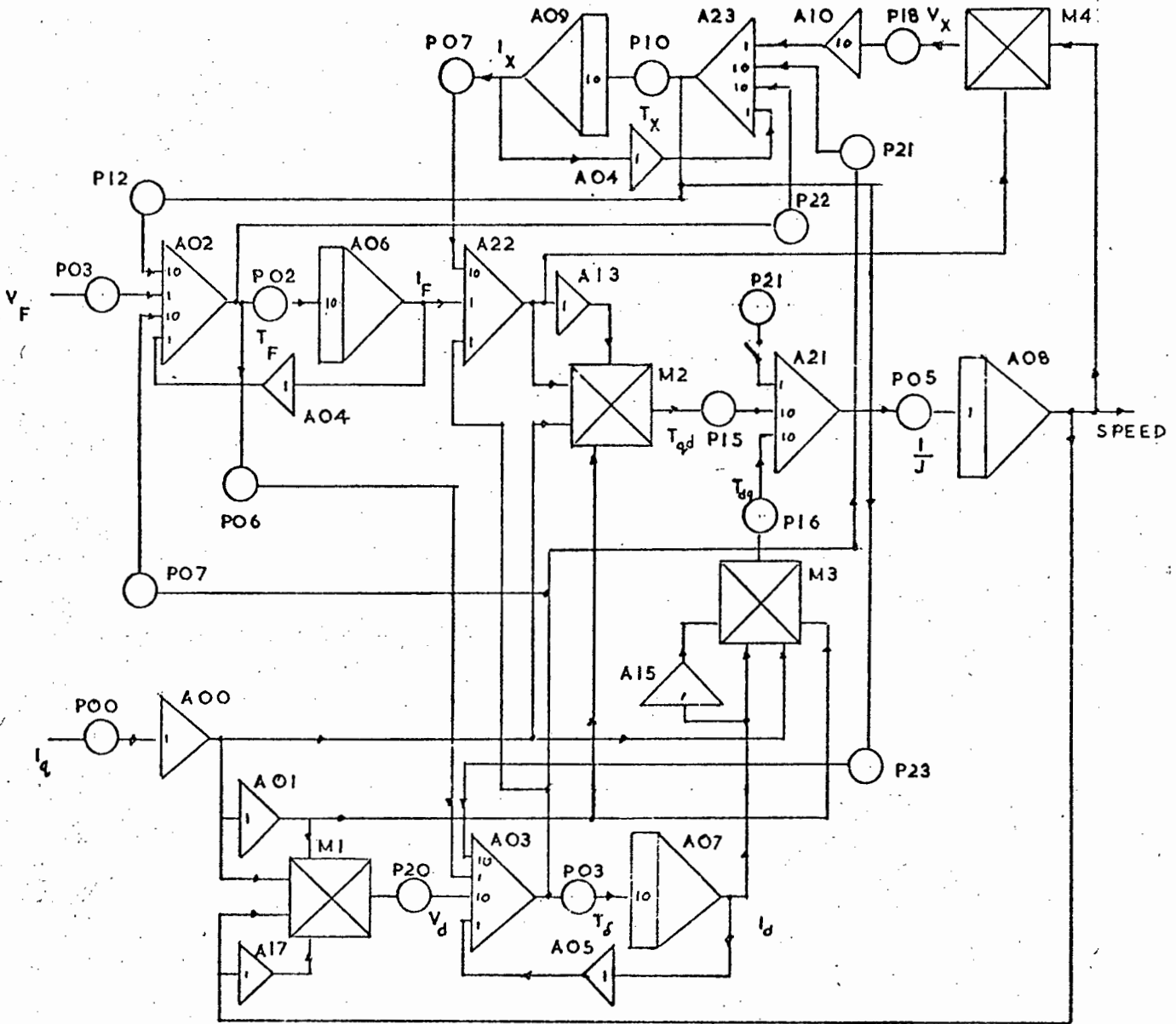


FIG 4.2 ANALOGUE COMPUTER BLOCK DIAGRAM

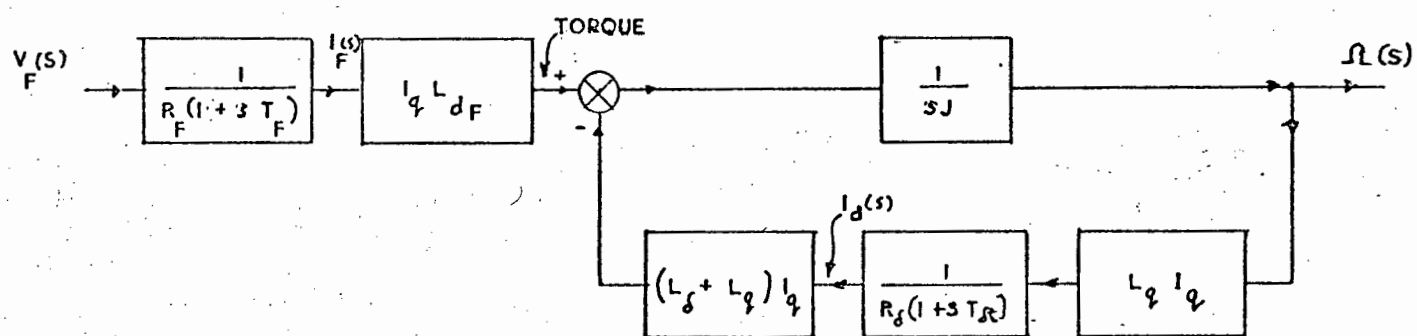


FIG 4.3: PERTURBATION DIAGRAM: SPEED/FIELD VOLTAGE
 (NO TRANSFORMER COUPLING)

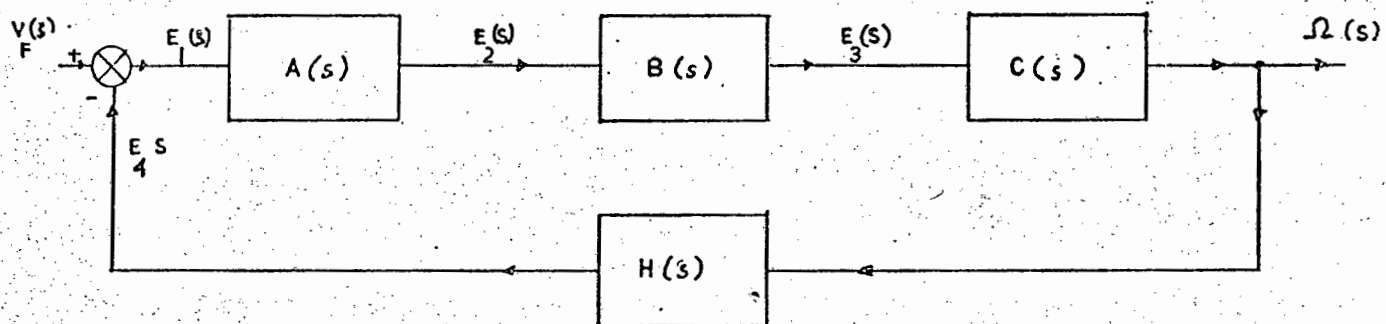


FIG 4.4: PERTURBATION DIAGRAM : SPEED/FIELD VOLTAGE
(WITH TRANSFORMER COUPLING)

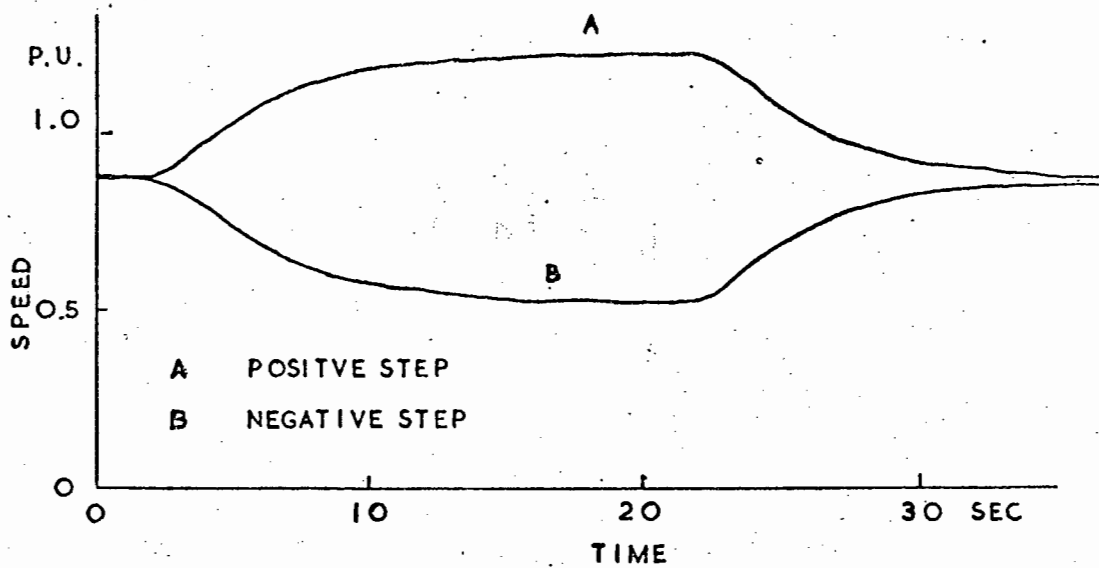


FIG. 4.5 SPEED RESPONSE FOR STEP IN V_F
WITHOUT TRANSFORMER COUPLING

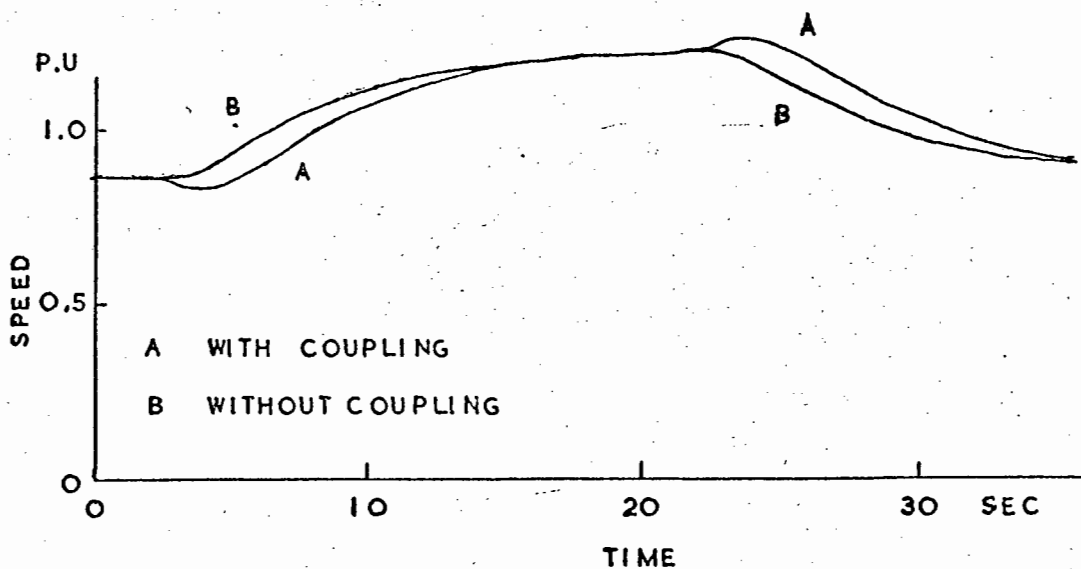


FIG. 4.6 SPEED RESPONSE FOR STEP IN V_F
EFFECT OF TRANSFORMER COUPLING

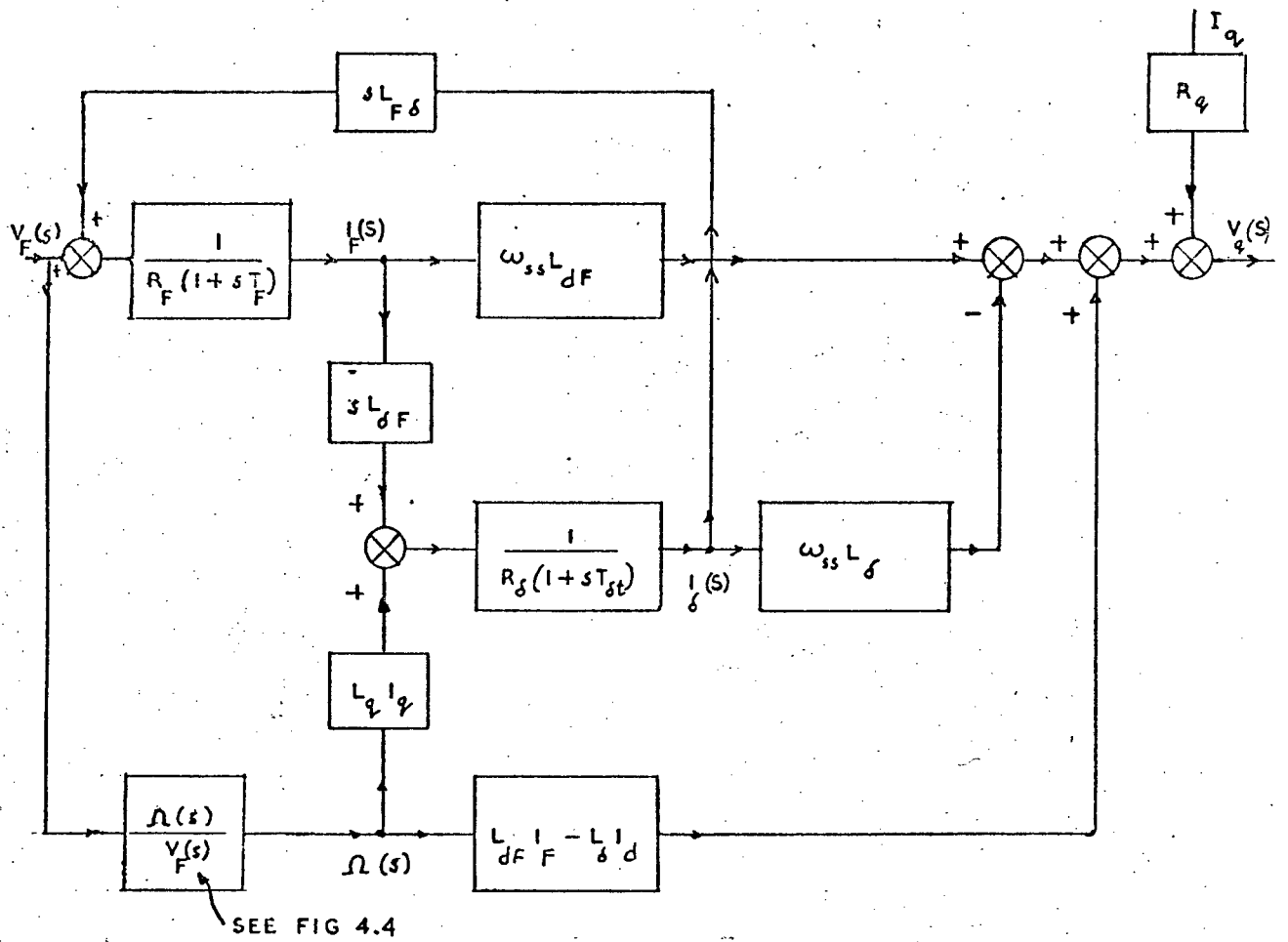


FIG 4.7 PERTURBATION DIAGRAM: INPUT VOLTAGE / FIELD VOLTAGE

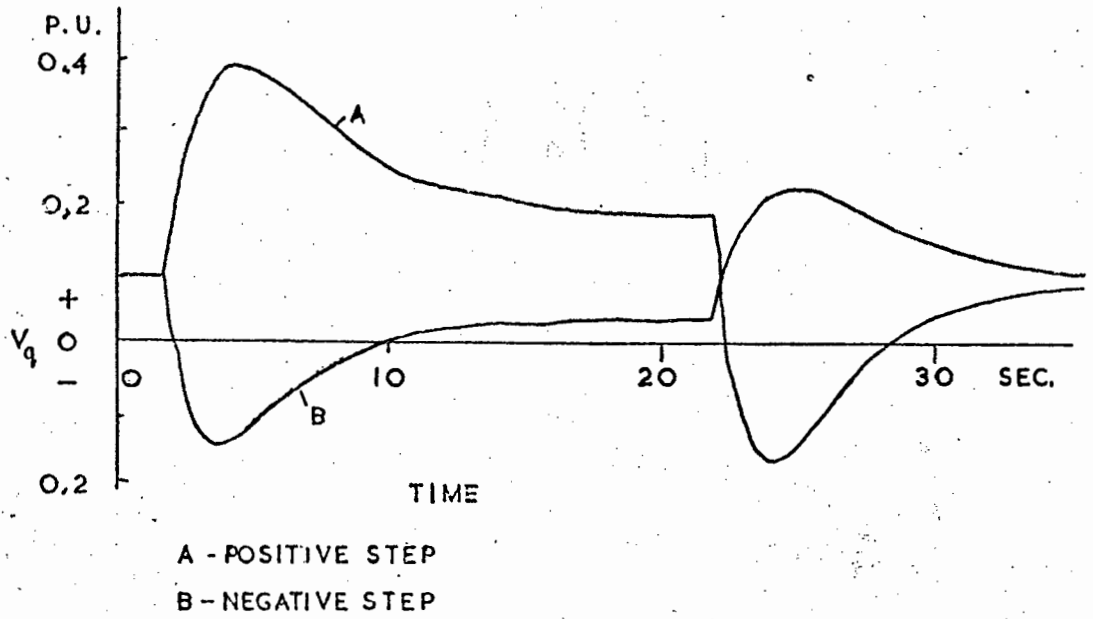


FIG 4.8 : RESPONSE OF V_q TO A STEP IN V_F —

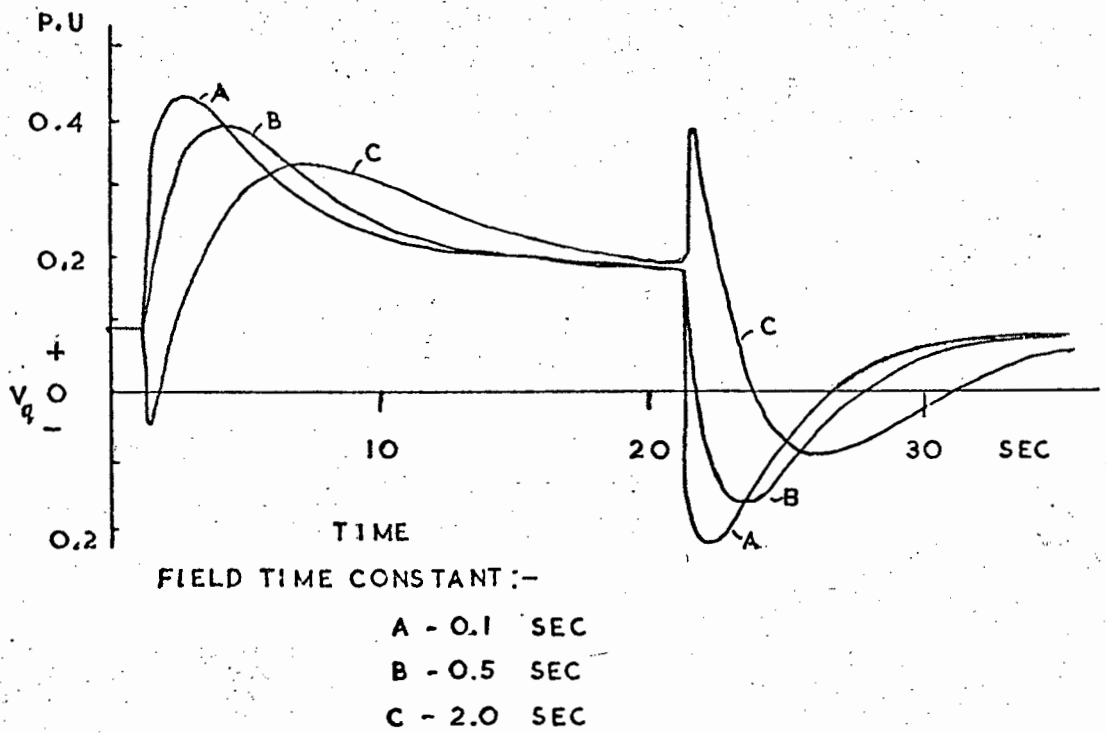


FIG 4.9 : RESPONSE OF V_q TO A STEP IN V_F :-
EFFECTS OF FIELD TIME CONSTANT

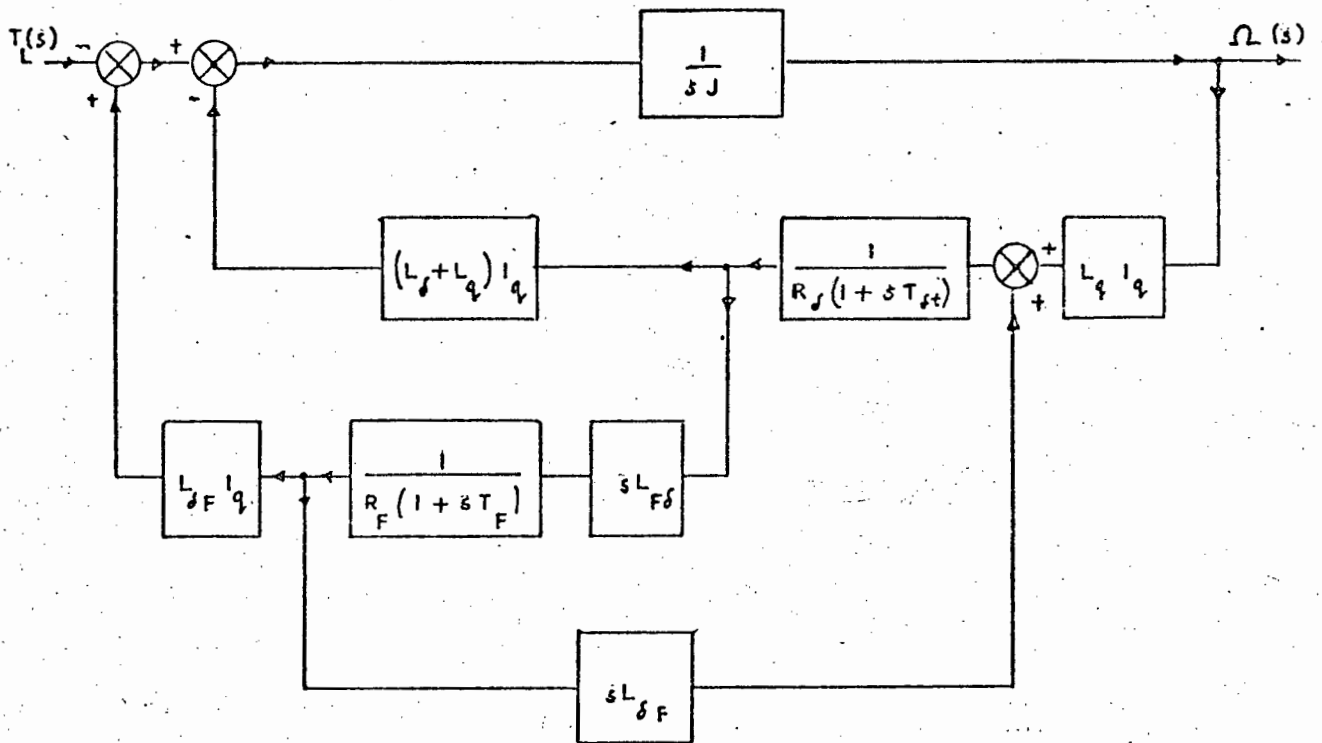


FIG 4.10 : PERTURBATION DIAGRAM : SPEED/LOAD TORQUE

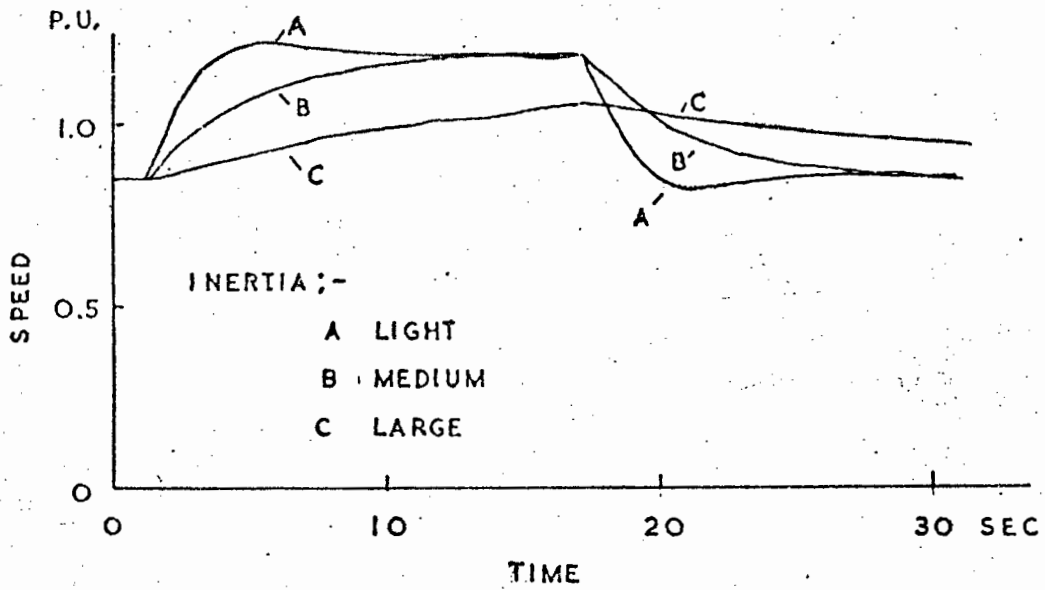


FIG 4.11 RESPONSE OF SPEED TO A STEP IN LOAD TORQUE:
EFFECT OF INERTIA

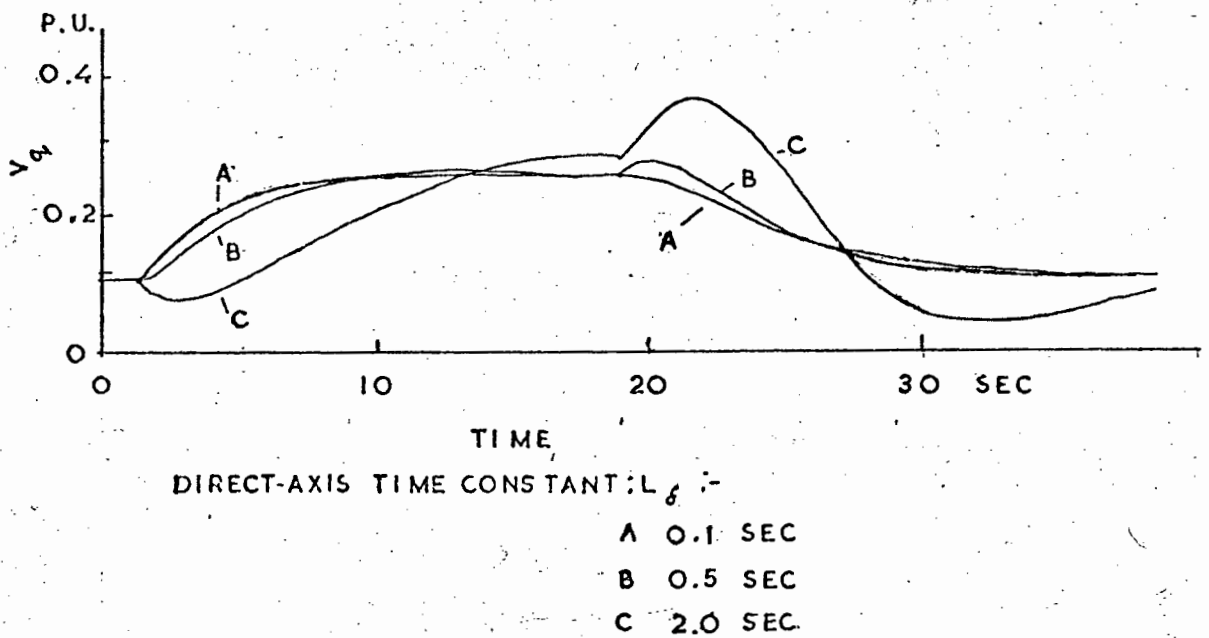


FIG.4.12 RESPONSE OF V_q TO A STEP IN LOAD TORQUE:
EFFECT OF DIRECT-AXIS TIME CONSTANT

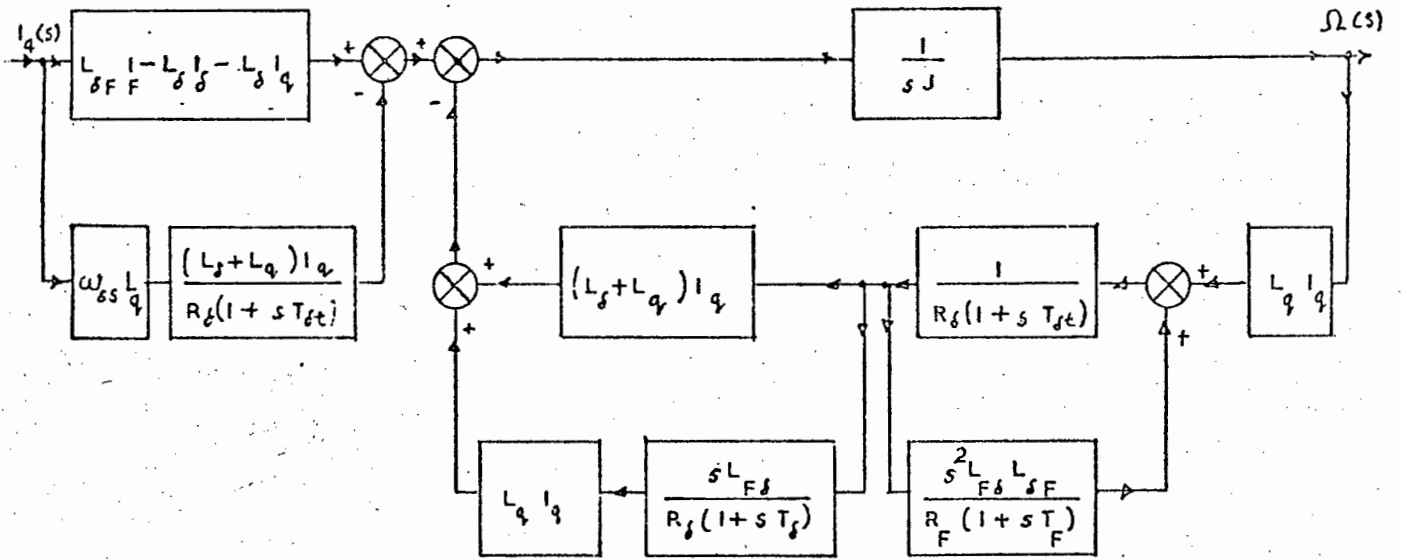


FIG 4.13 PERTURBATION DIAGRAM: SPEED / INPUT CURRENT

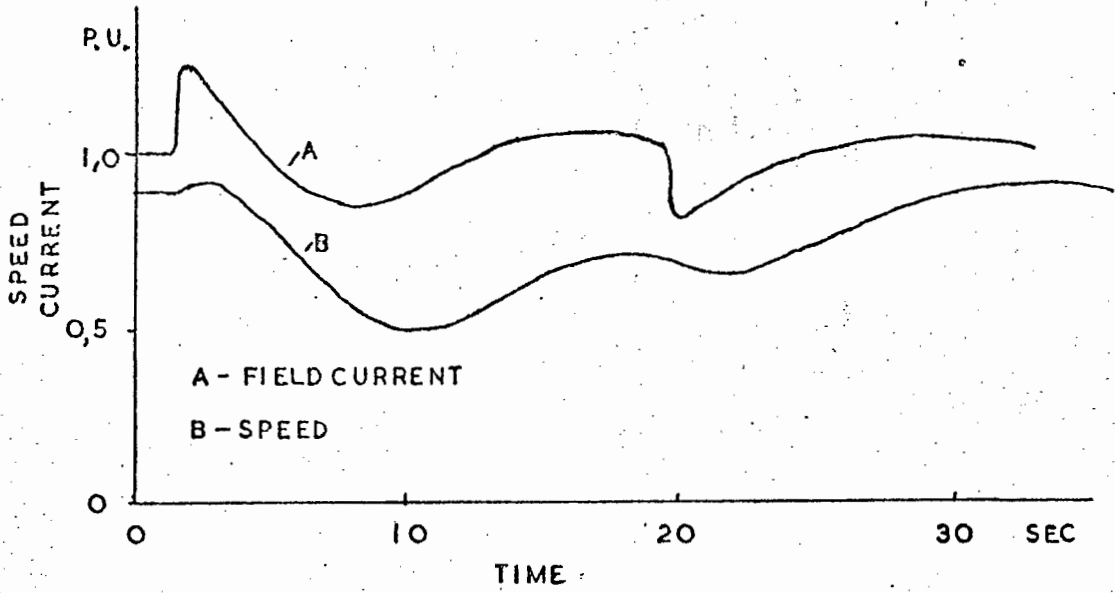


FIG 4.14 FIELD CURRENT AND SPEED RESPONSE TO A STEP IN INPUT CURRENT

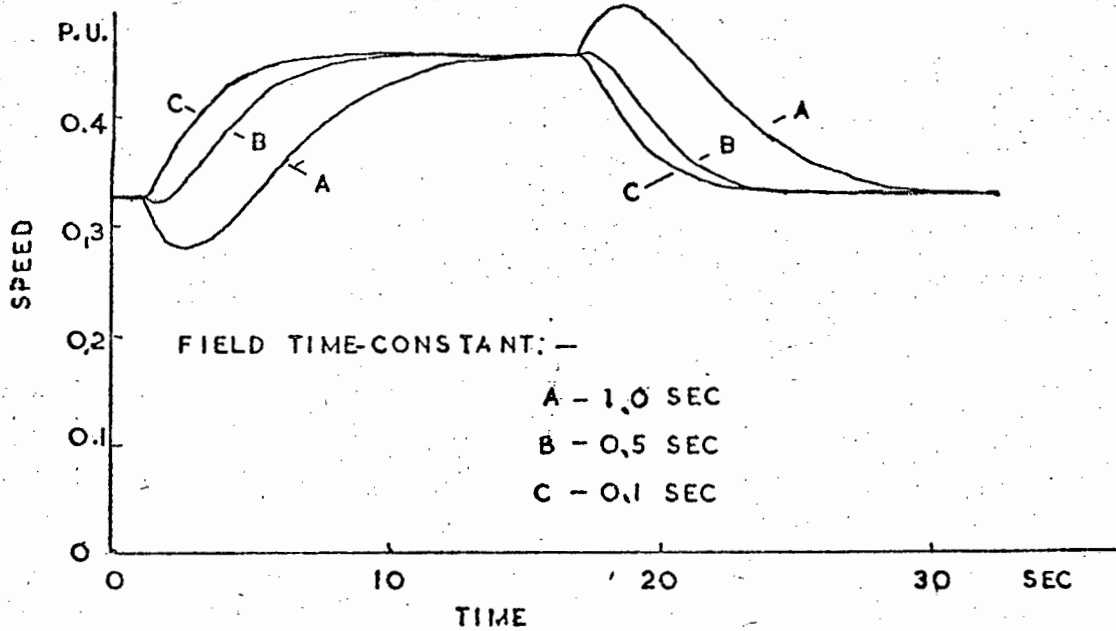


FIG 4.15 SPEED RESPONSE TO A STEP IN V_f WITH A REDUCTION IN DIRECT-AXIS FIELD WINDING TURNS

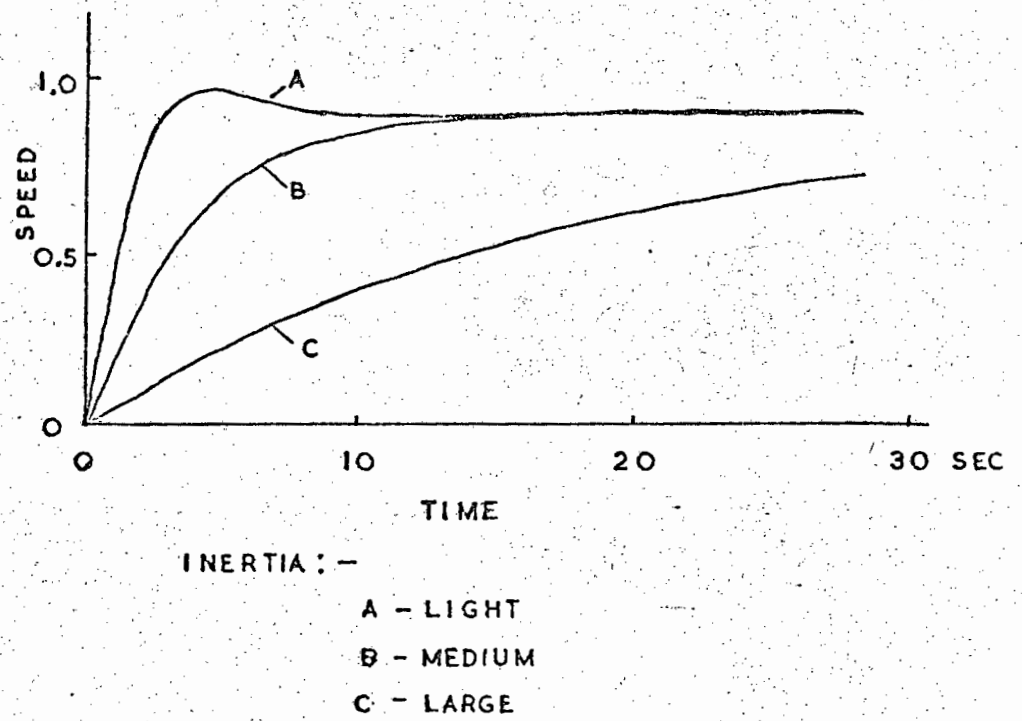


FIG 4.16. STARTING OF CROSS-FIELD MOTOR

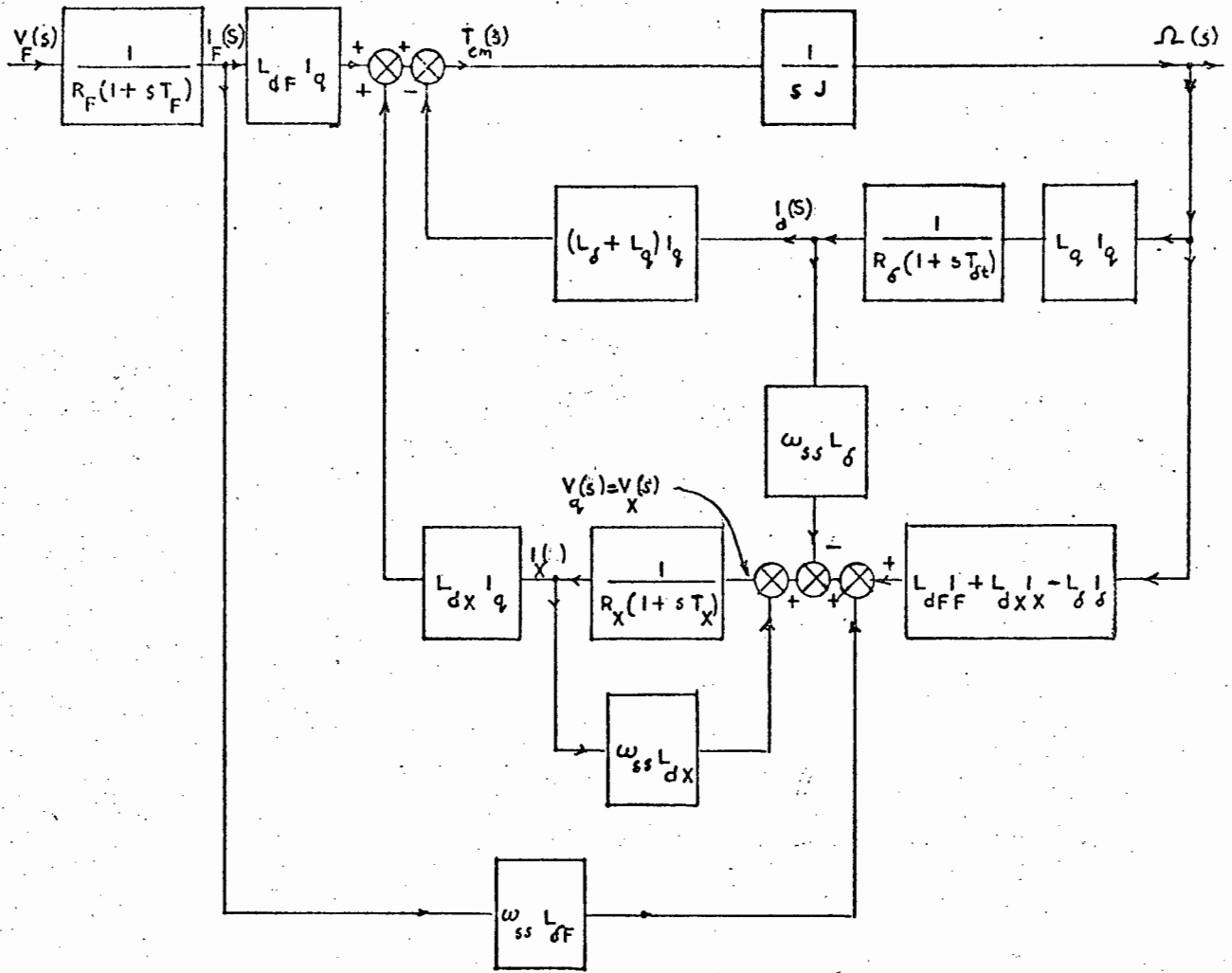


FIG 4.17 : PERTURBATION DIAGRAM: SPEED / FIELD VOLTAGE

WITH VOLTAGE FEEDBACK : WITHOUT TRANSFORMER COUPLING

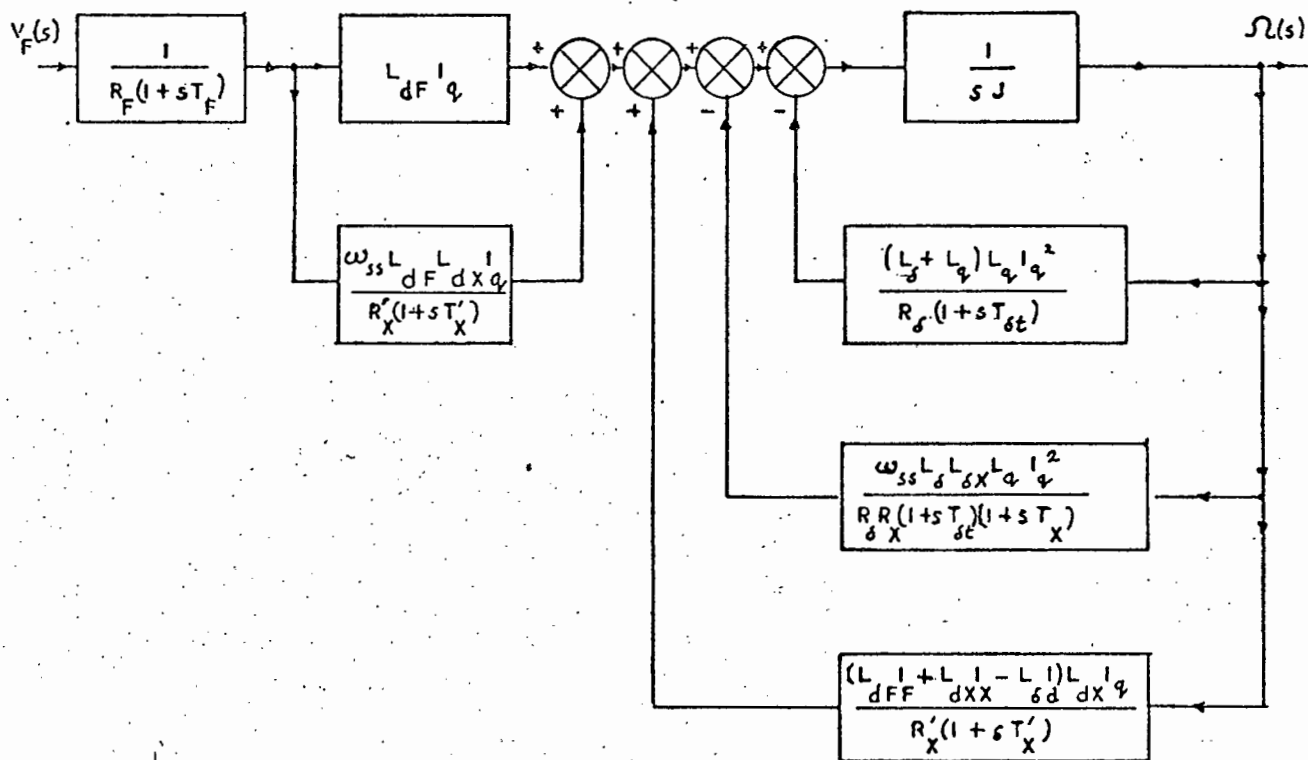


FIG 4.18: REVISED PERTURBATION DIAGRAM: SPEED/FIELD VOLTAGE

WITH VOLTAGE FEEDBACK WITHOUT TRANSFORMER COUPLING

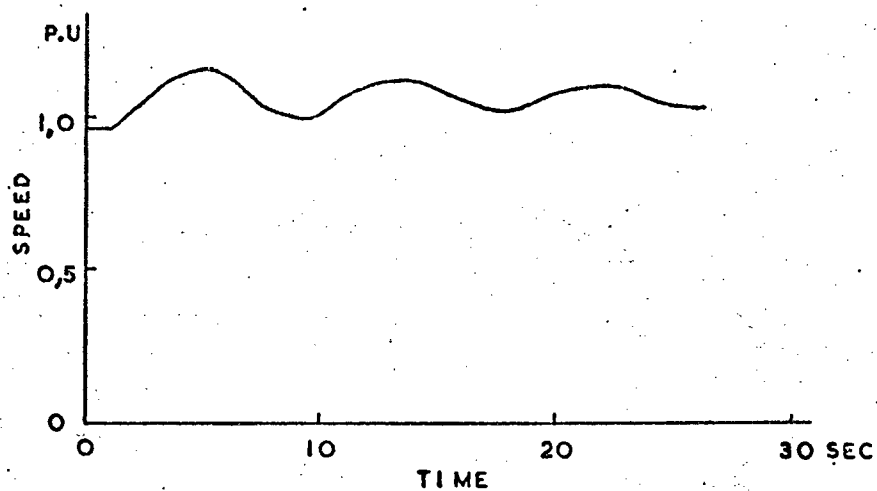


FIG. 4.19 : SPEED RESPONSE TO A STEP IN V_F WITH VOLTAGE

FEEDBACK : $T_{\delta t}$ LARGE

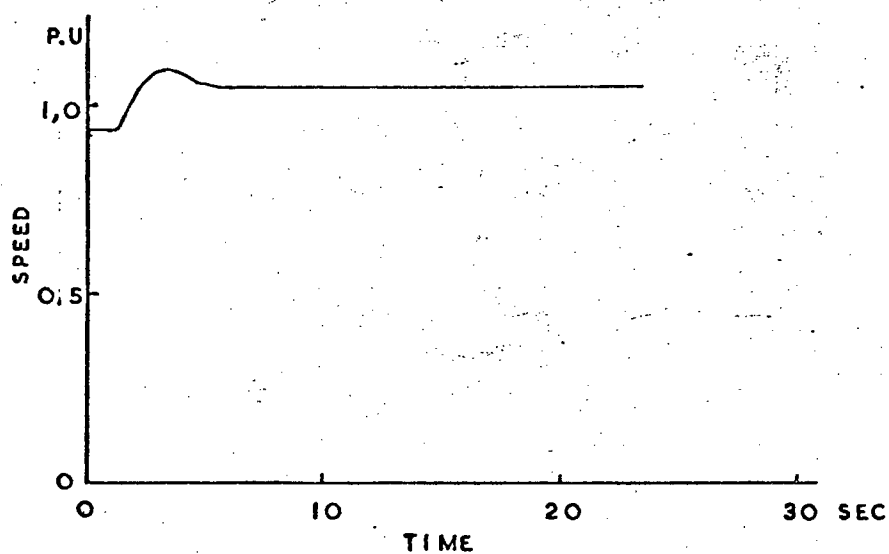


FIG. 4.20 SPEED RESPONSE TO A STEP IN V_F WITH VOLTAGE

FEEDBACK : LOW INERTIA : $T_{\delta t}$ MEDIUM

CHAPTER 5 : THE STATIC CONVERTER

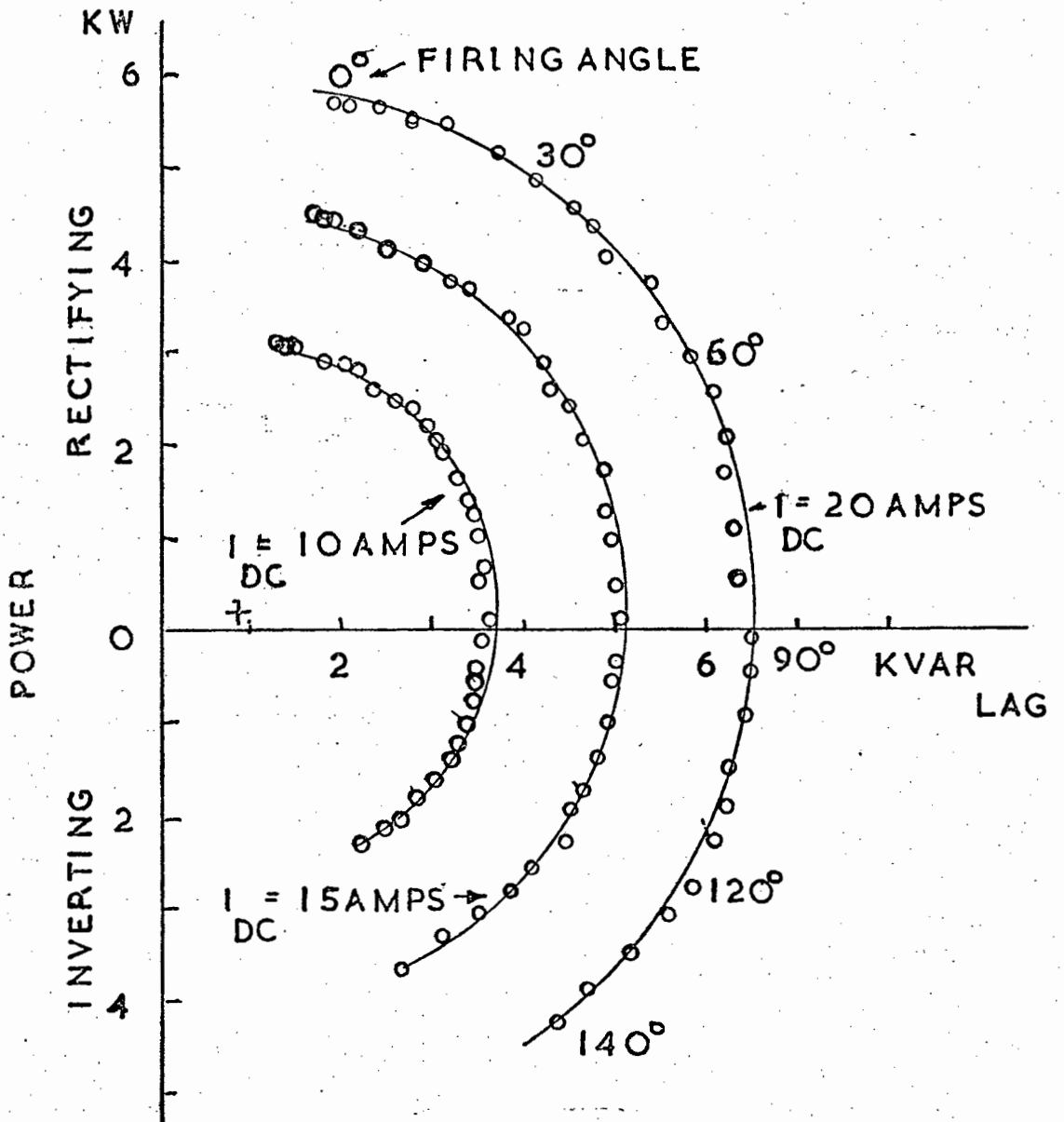


FIG 5.1 CONVERTER CIRCLE DIAGRAM

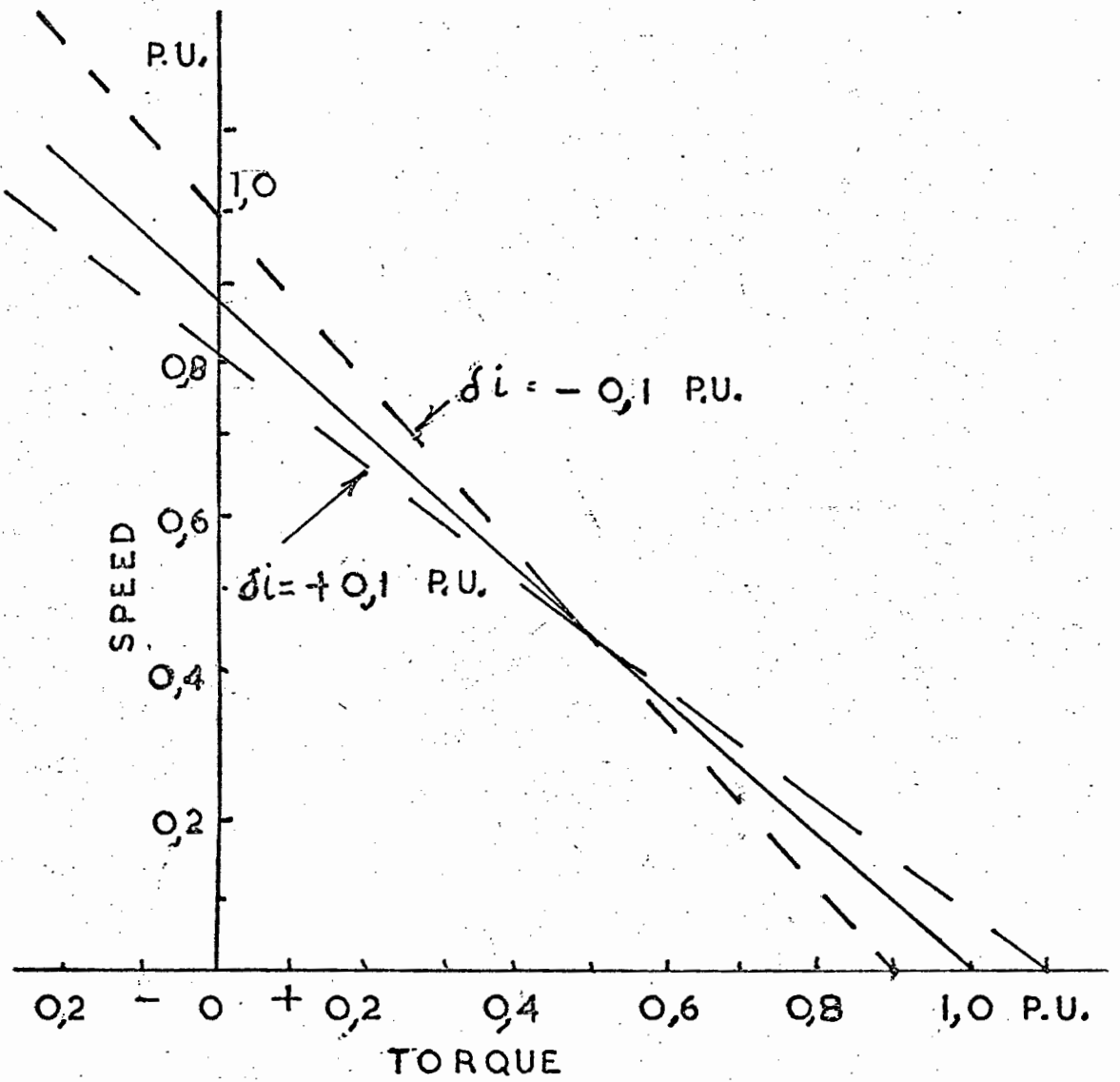


FIG 5.2. EFFECT OF δl

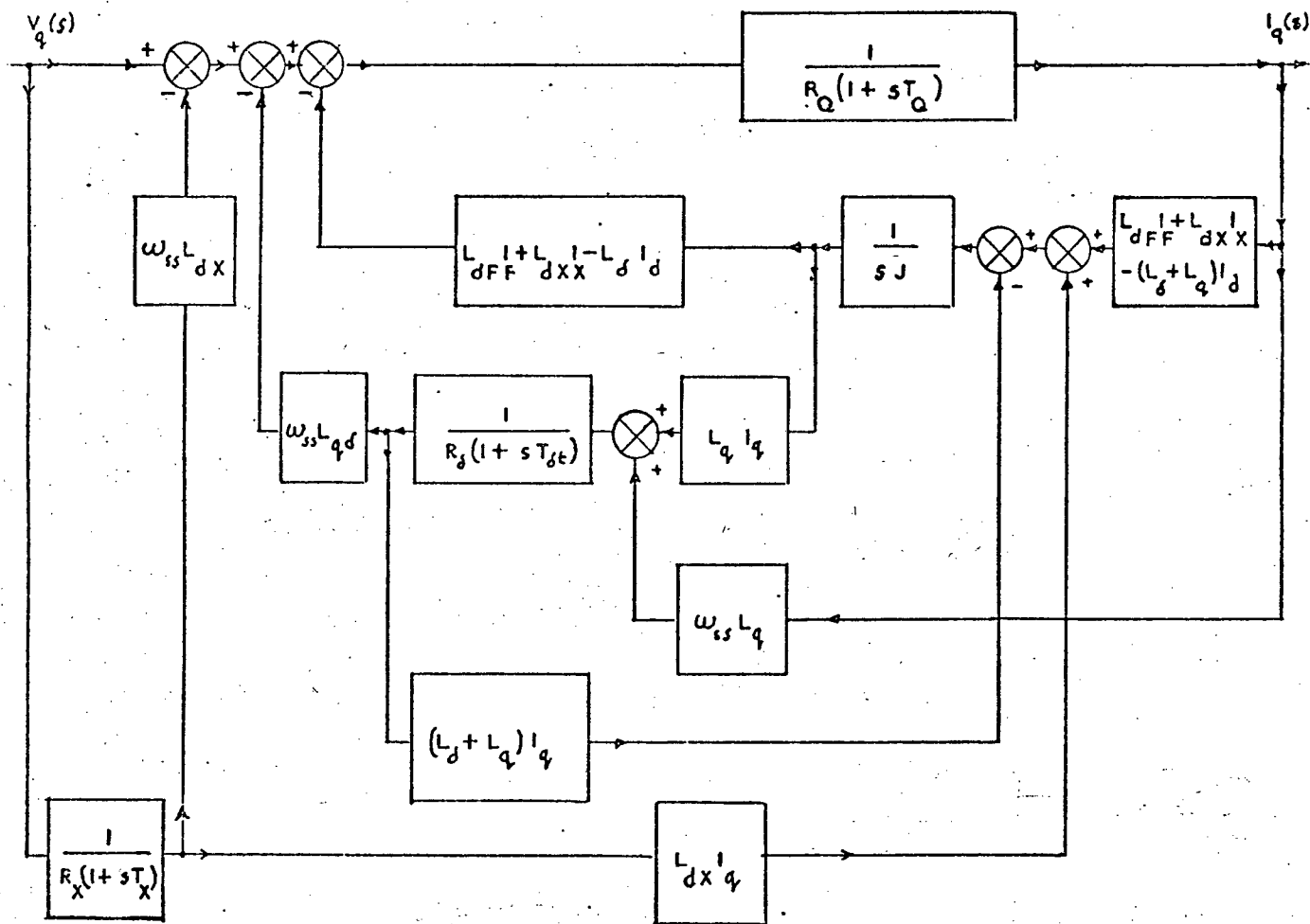
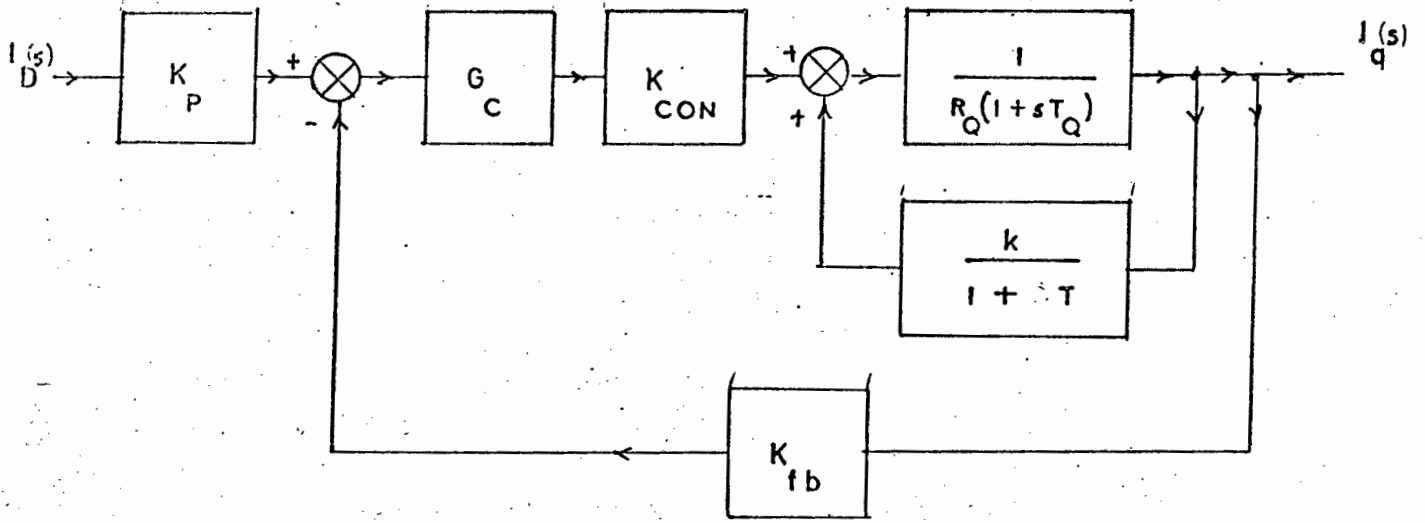
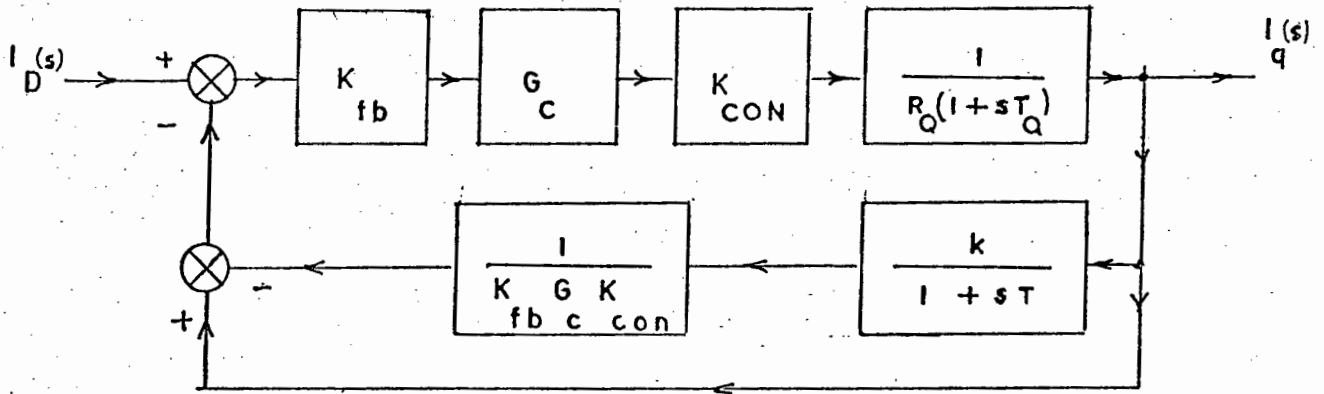


FIG 5.3 PERTURBATION DIAGRAM: INPUT CURRENT / INPUT VOLTAGE



a

THIS CAN BE REDRAWN AS:-



b

FIG 5.4 CURRENT CONTROLLER BLOCK DIAGRAMS

CHAPTER 6 : LABORATORY TESTS ON A COMPLETE DRIVE

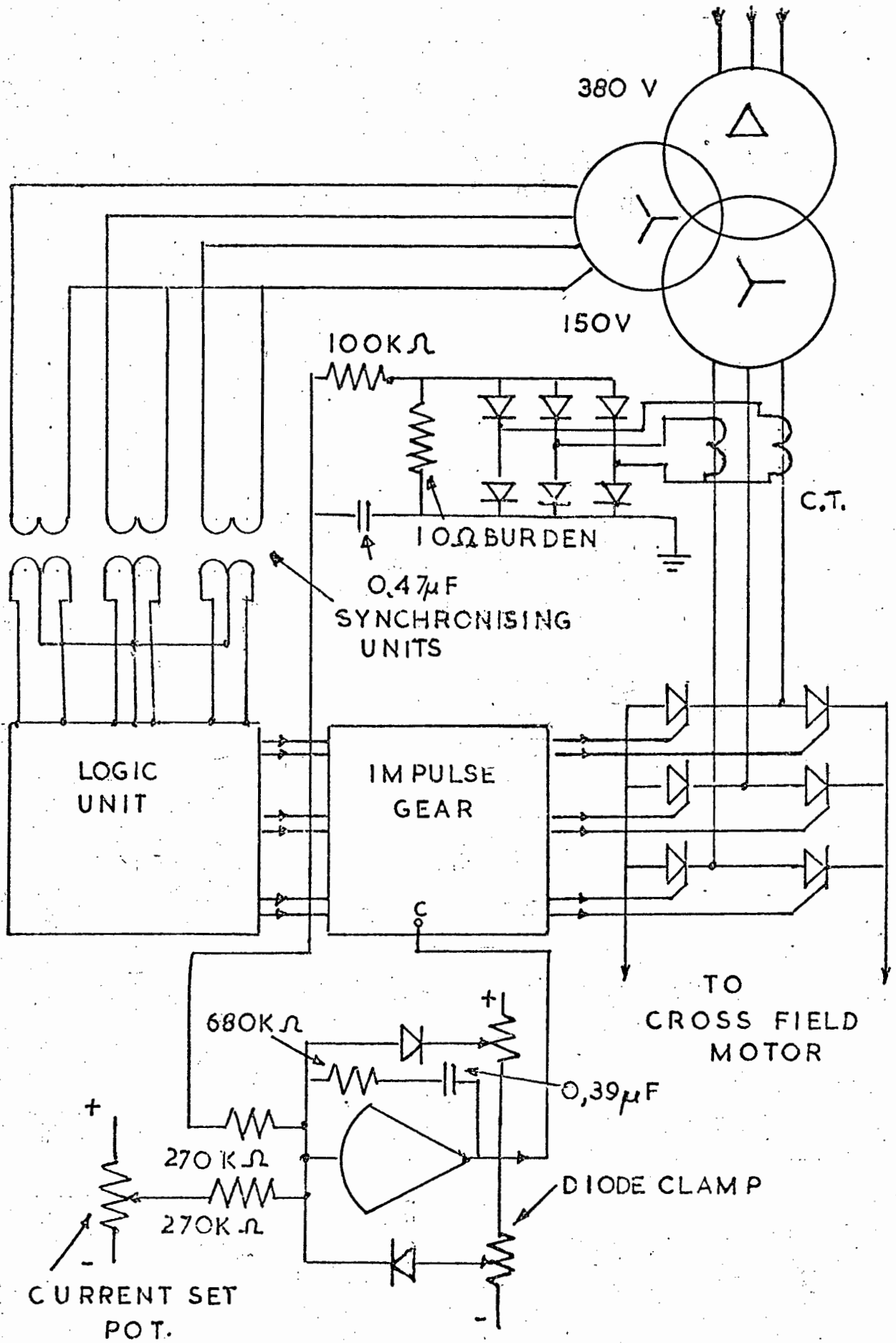
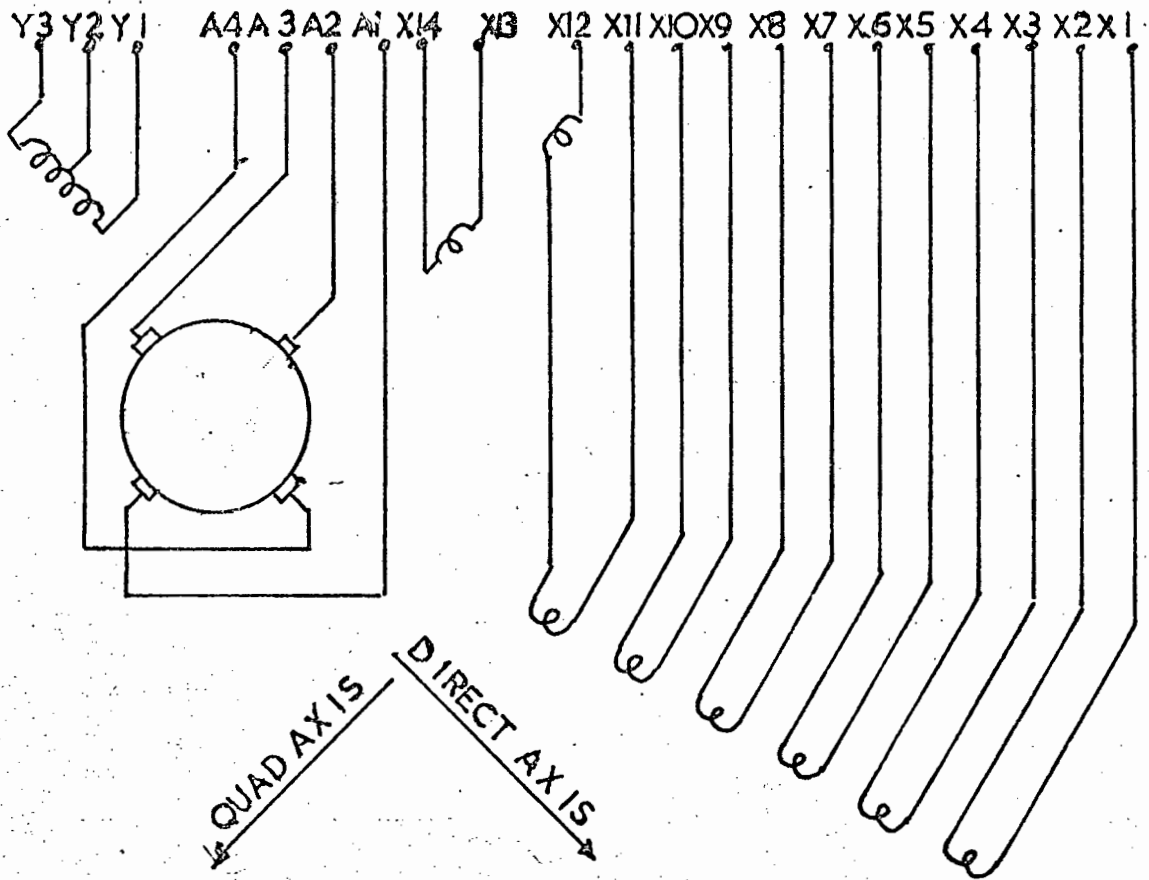


FIG. 6.1 : DIAGRAM OF CONVERTER



WINDING	NO. OF TURNS	RESISTANCE	RATED CURRENT
X1 - X2	440	183,4	0,4
X3 X4	440	182,2	0,4
X5 X6	100	7,8	2,0
X7 X8	50	4,3	2,0
X9 X10	20	0,36	14,8
X11 X12	DEMAG WINDING		0,15 AC
X13 X14	60	55,0	2,0
Y1 Y2	66	1,14	12,5
A2 A3	60	1,13	12,5

FIG 6.2 MOTOR CONNECTION DIAGRAM

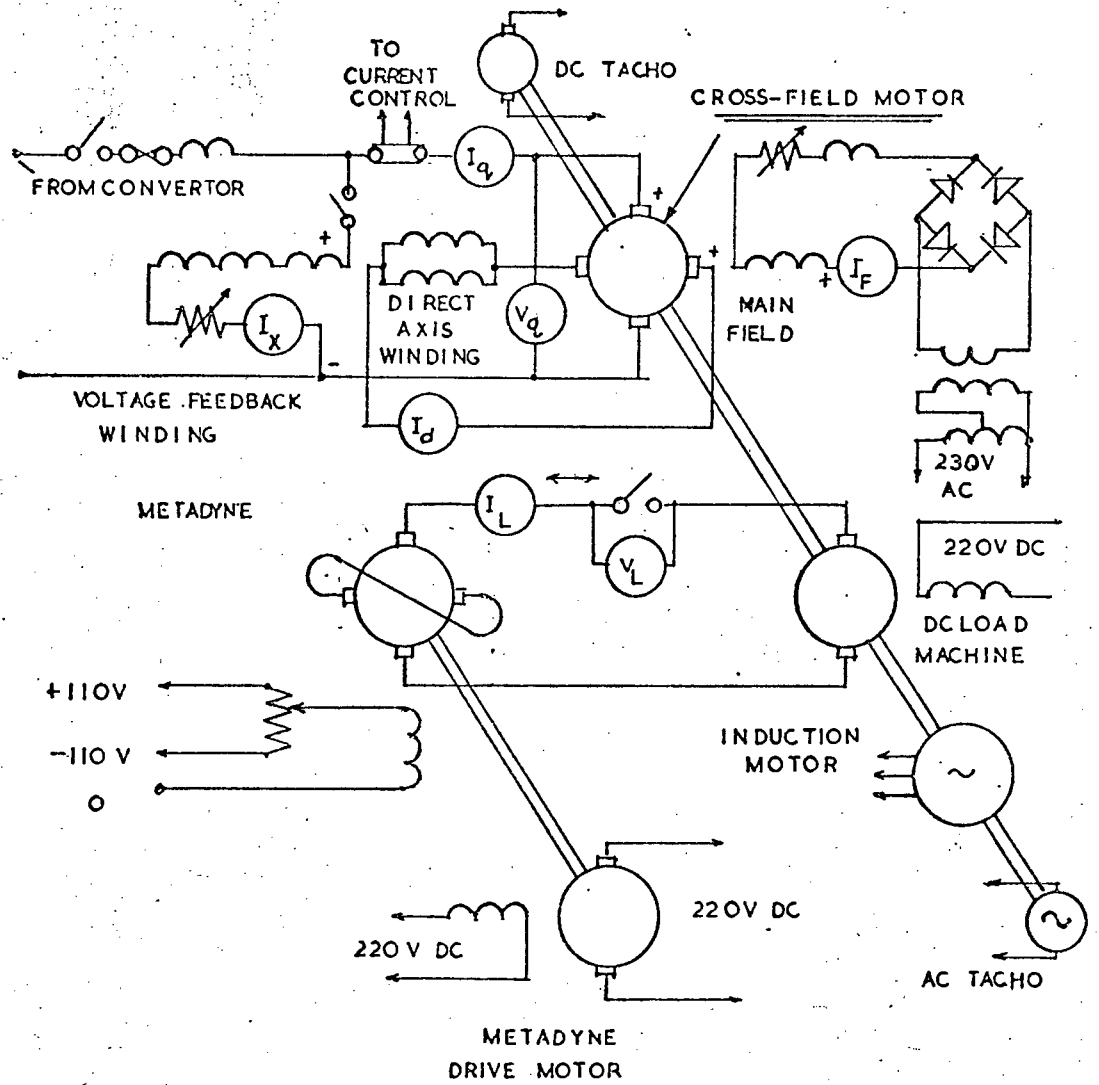


FIG 6.3 DIAGRAM OF LABORATORY DRIVE

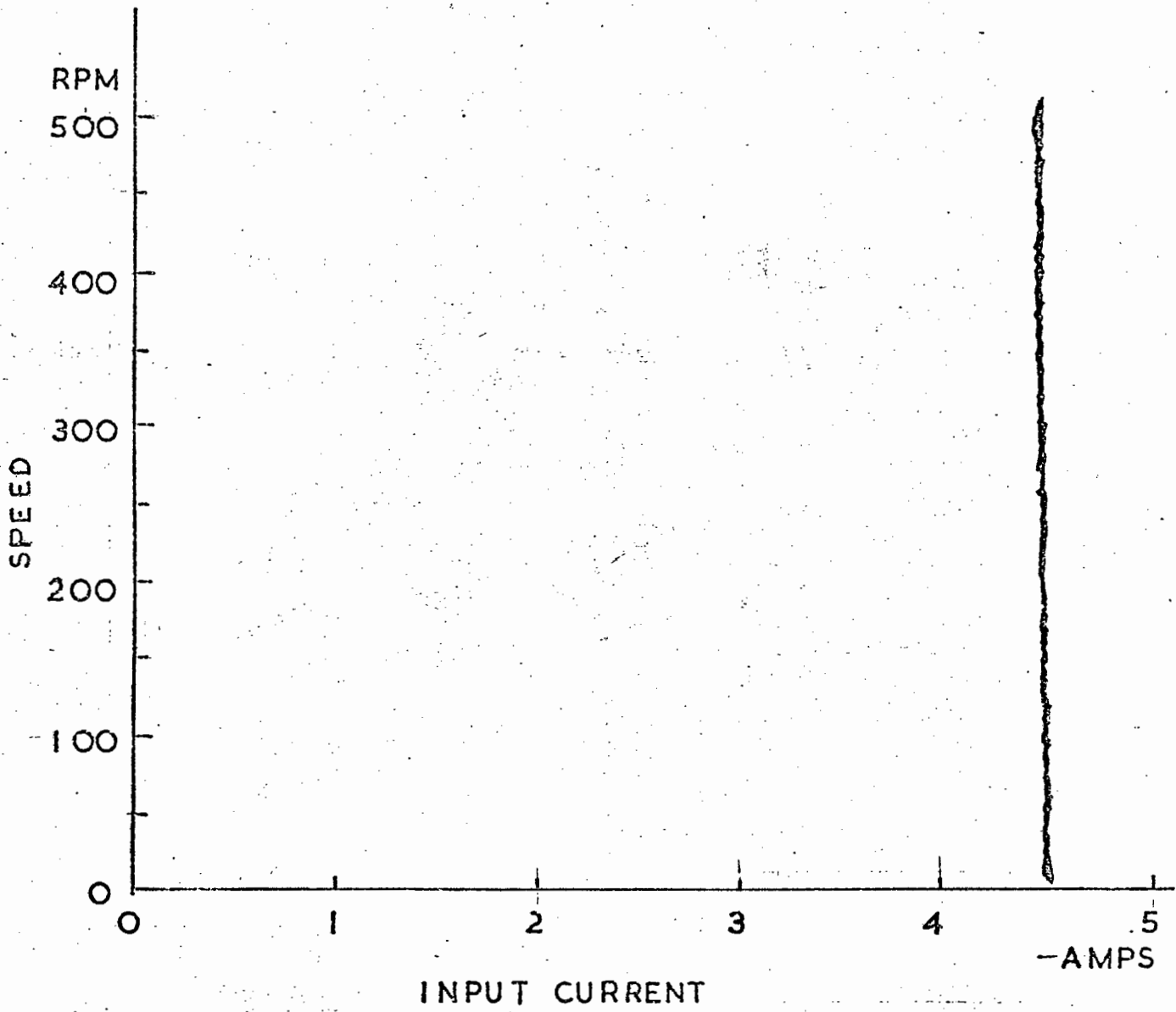


FIG 6.4 ARMATURE CURRENT/SPEED
NO VOLTAGE FEEDBACK

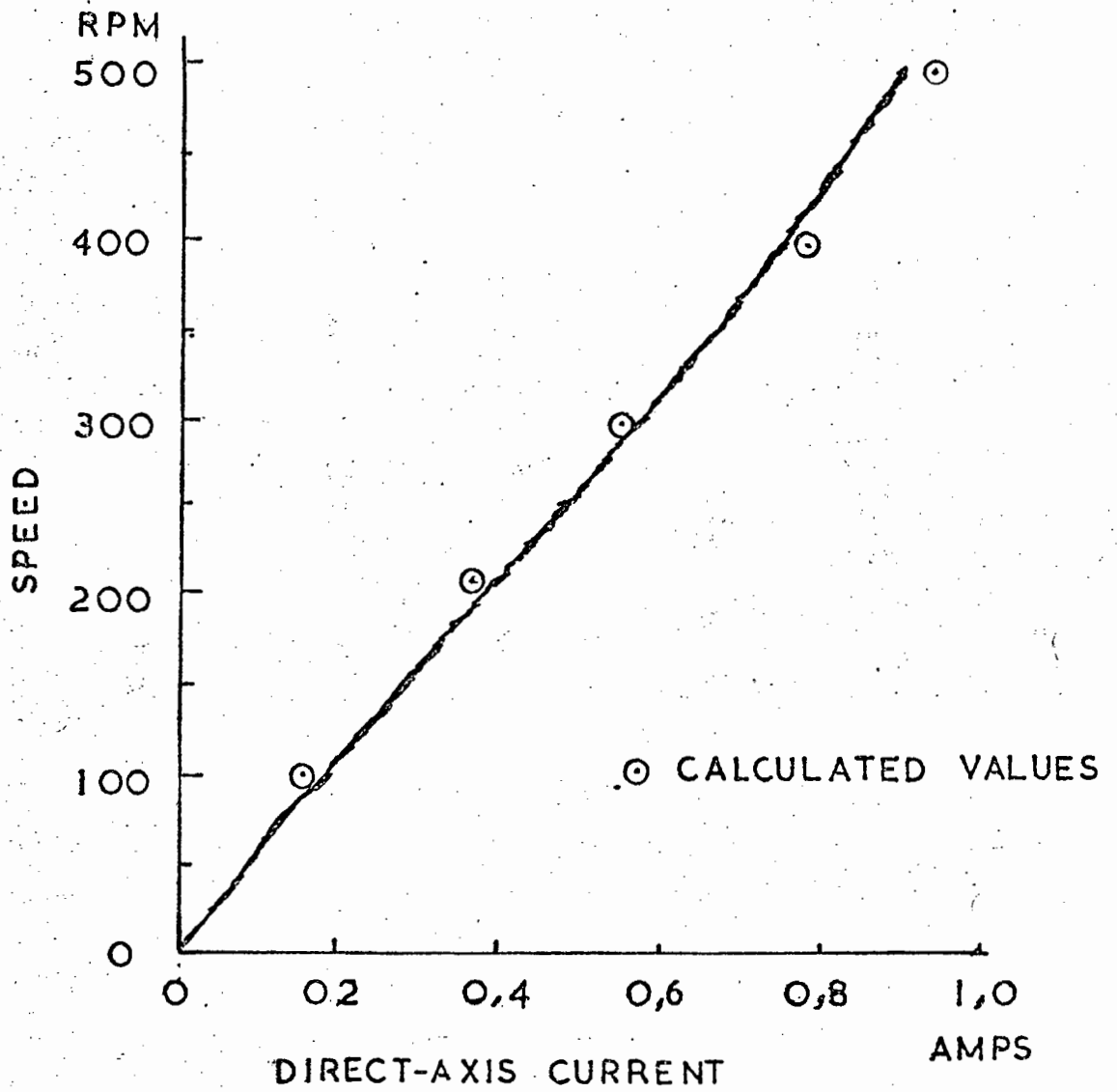


FIG 6.5. DIRECT-AXIS CURRENT/SPEED CURVE

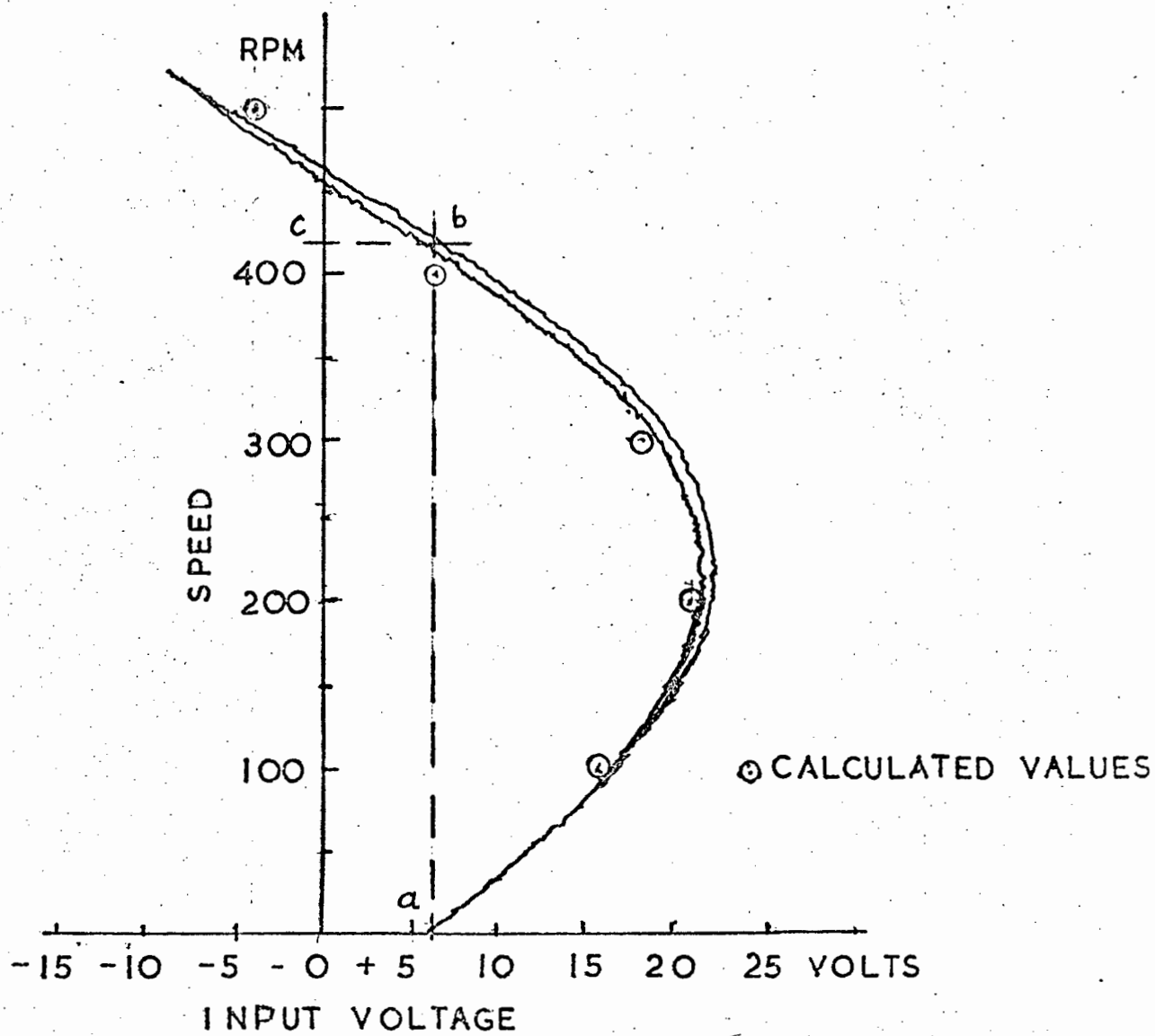


FIG.6.6 INPUT VOLTAGE / SPEED CURVE

NO VOLTAGE FEEDBACK

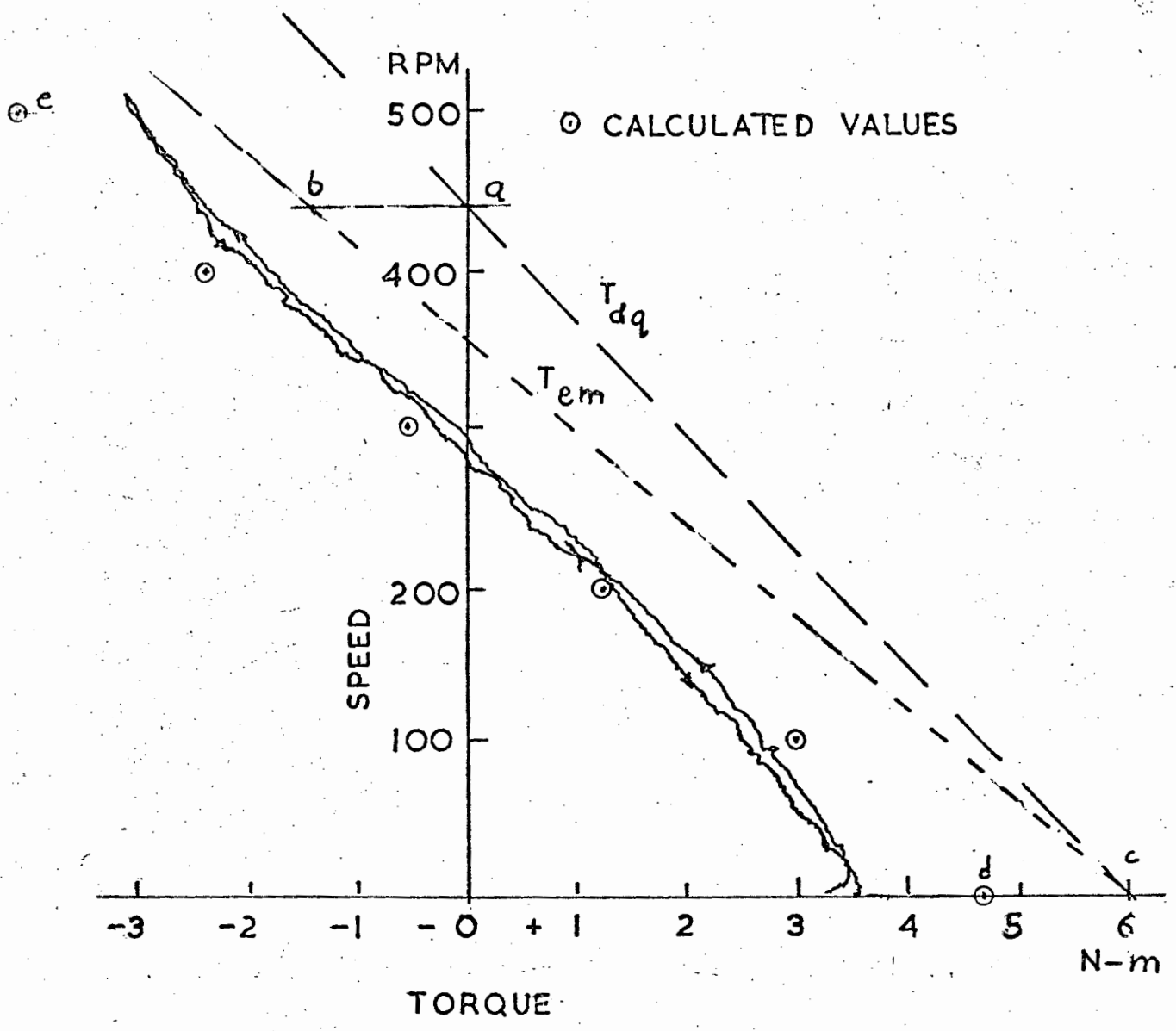


FIG 6.7 TORQUE/SPEED CURVE
NO VOLTAGE FEEDBACK

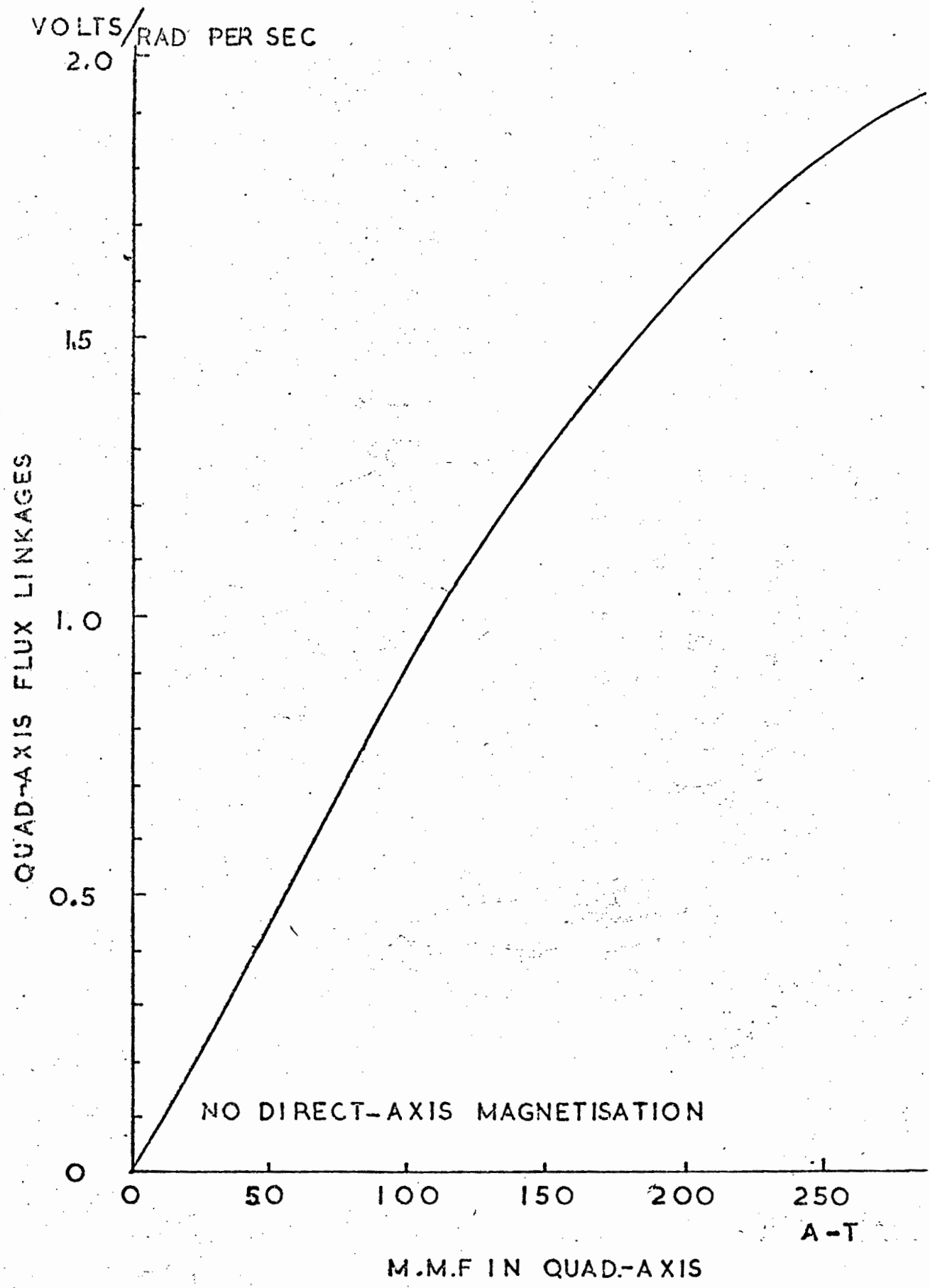


FIG. 6.8. QUAD-AXIS FLUX-LINKAGES

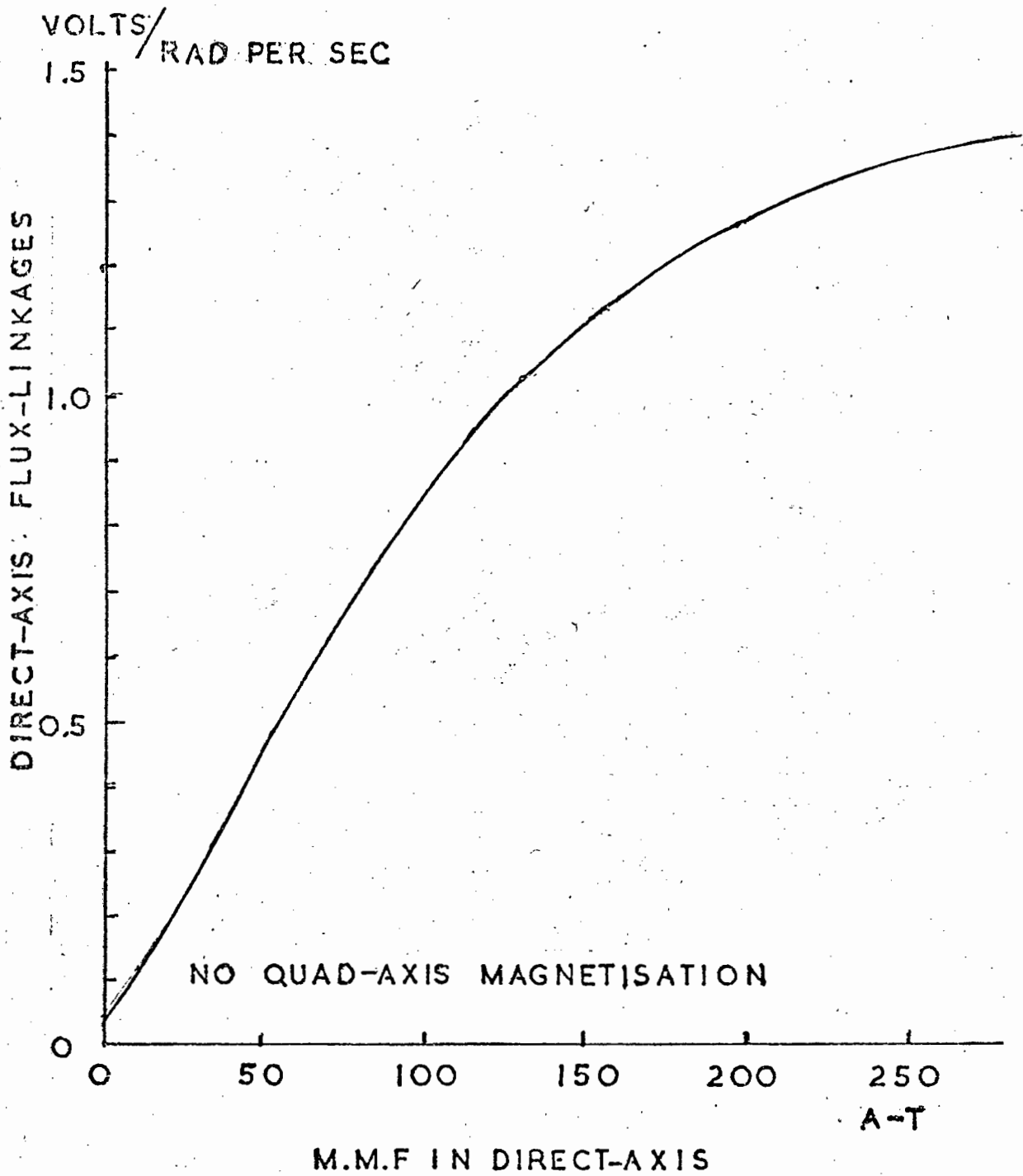


FIG 6.9 DIRECT-AXIS FLUX-LINKAGES

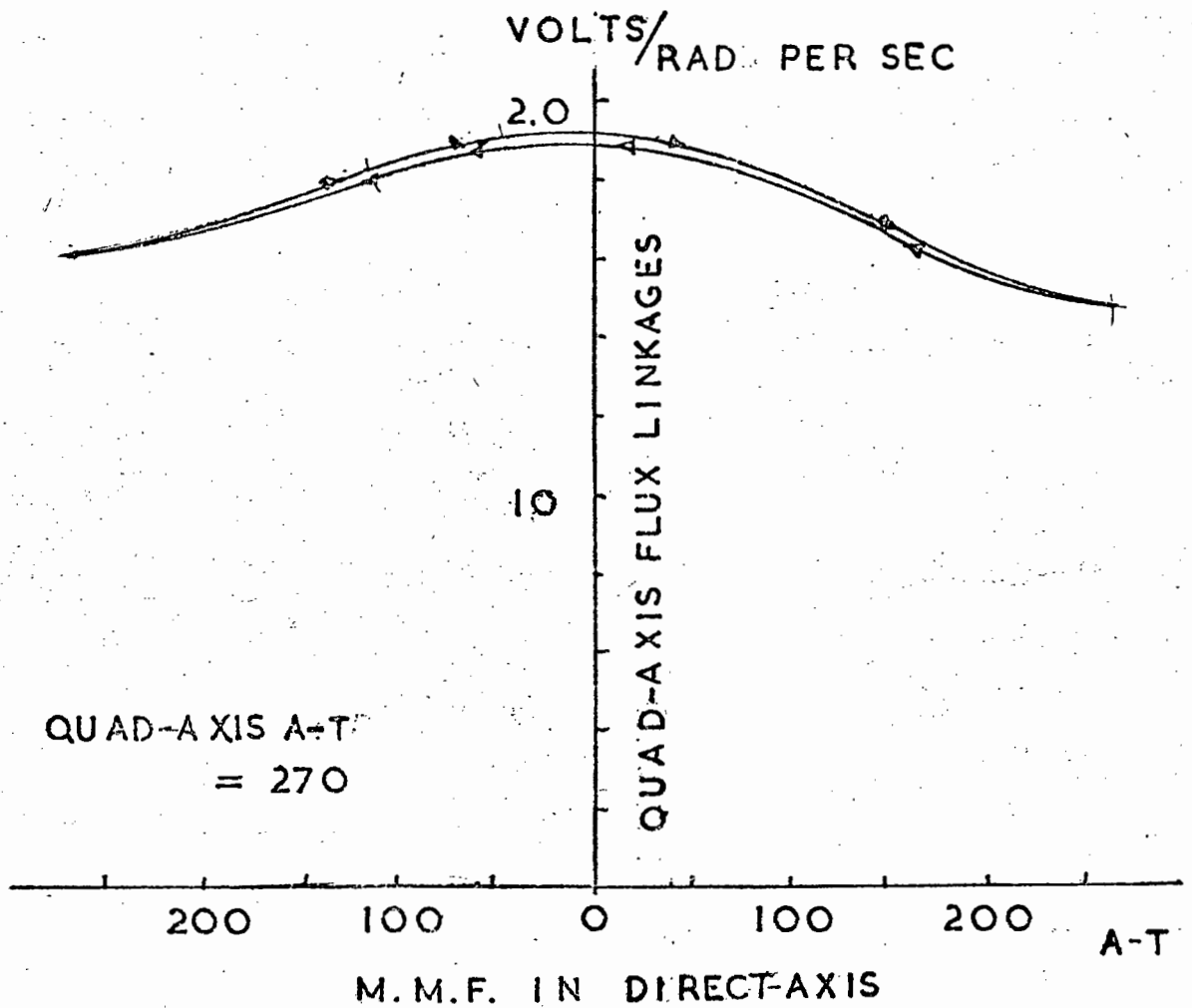


FIG 6.10 EFFECT OF DIRECT-AXIS M.M.F. ON
QUAD - AXIS FLUX-LINKAGE

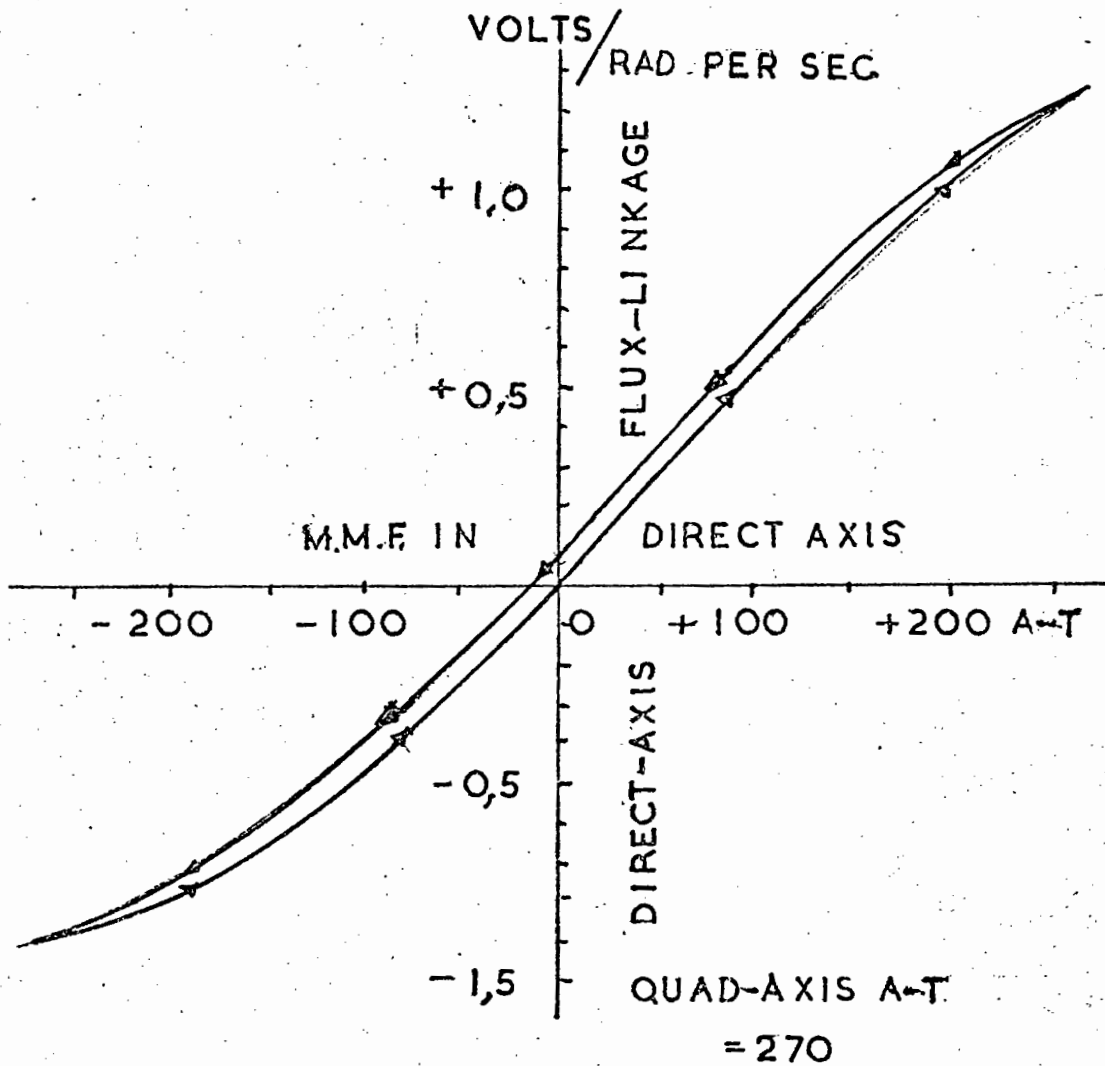


FIG 6.11 EFFECT OF CONSTANT QUAD-AXIS M.M.F. ON
DIRECT-AXIS FLUX-LINKAGES

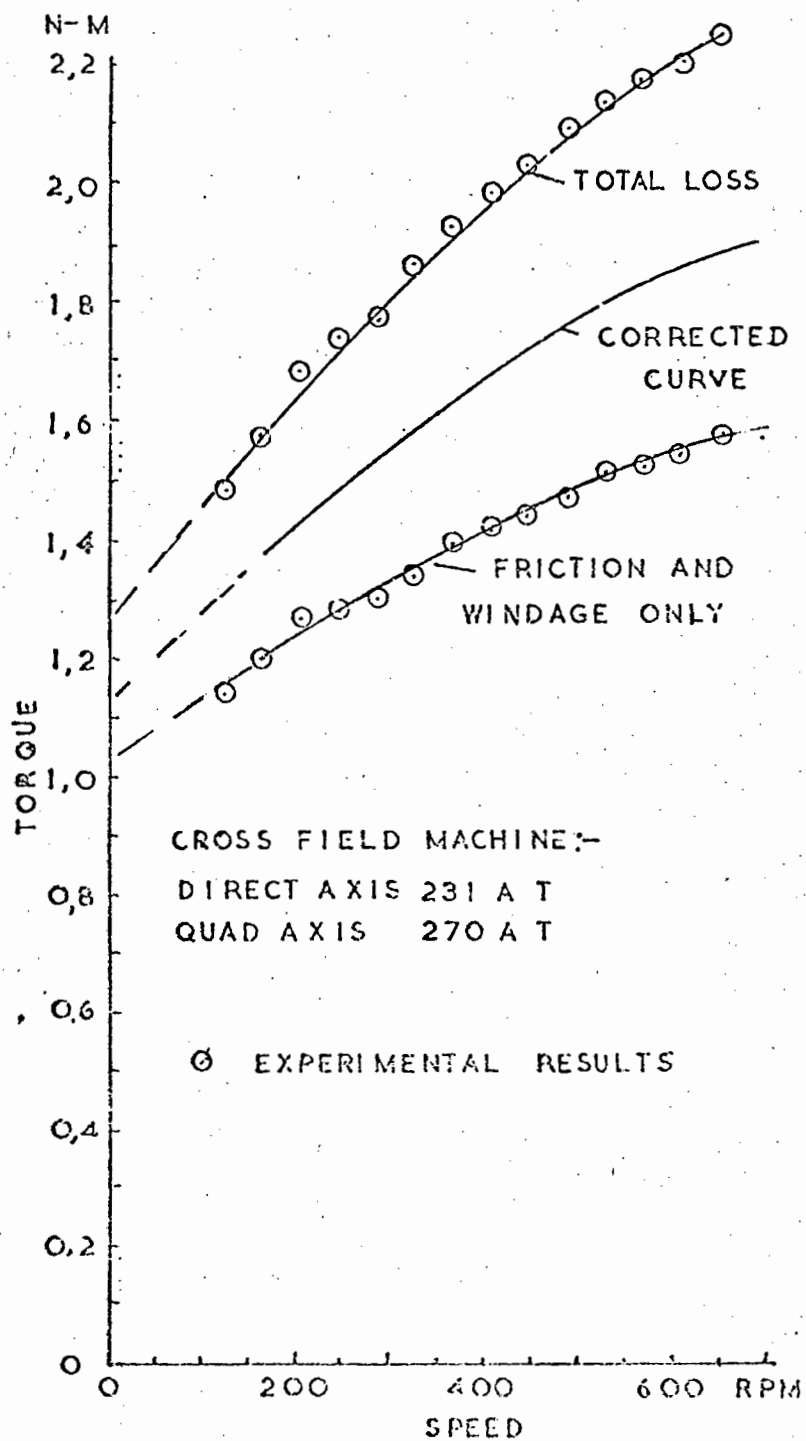
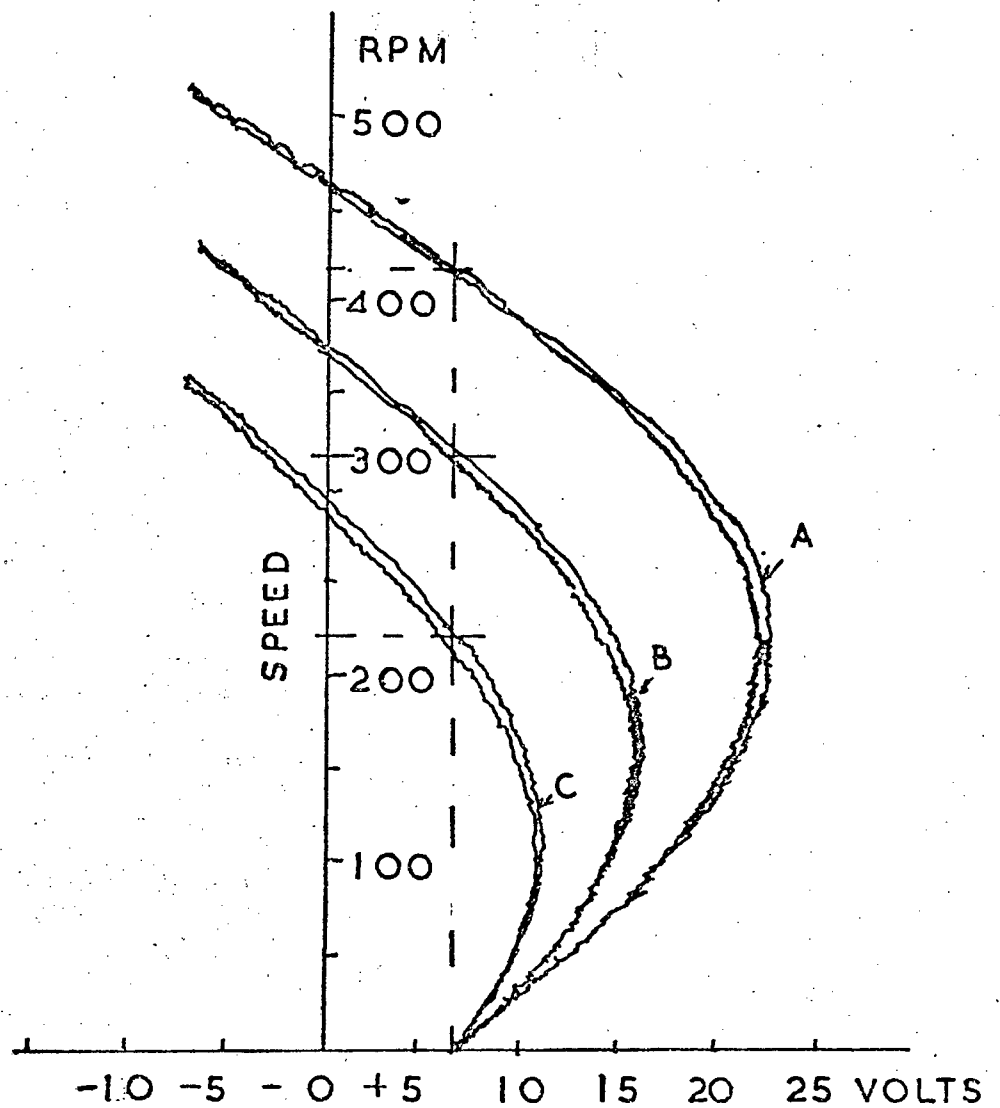


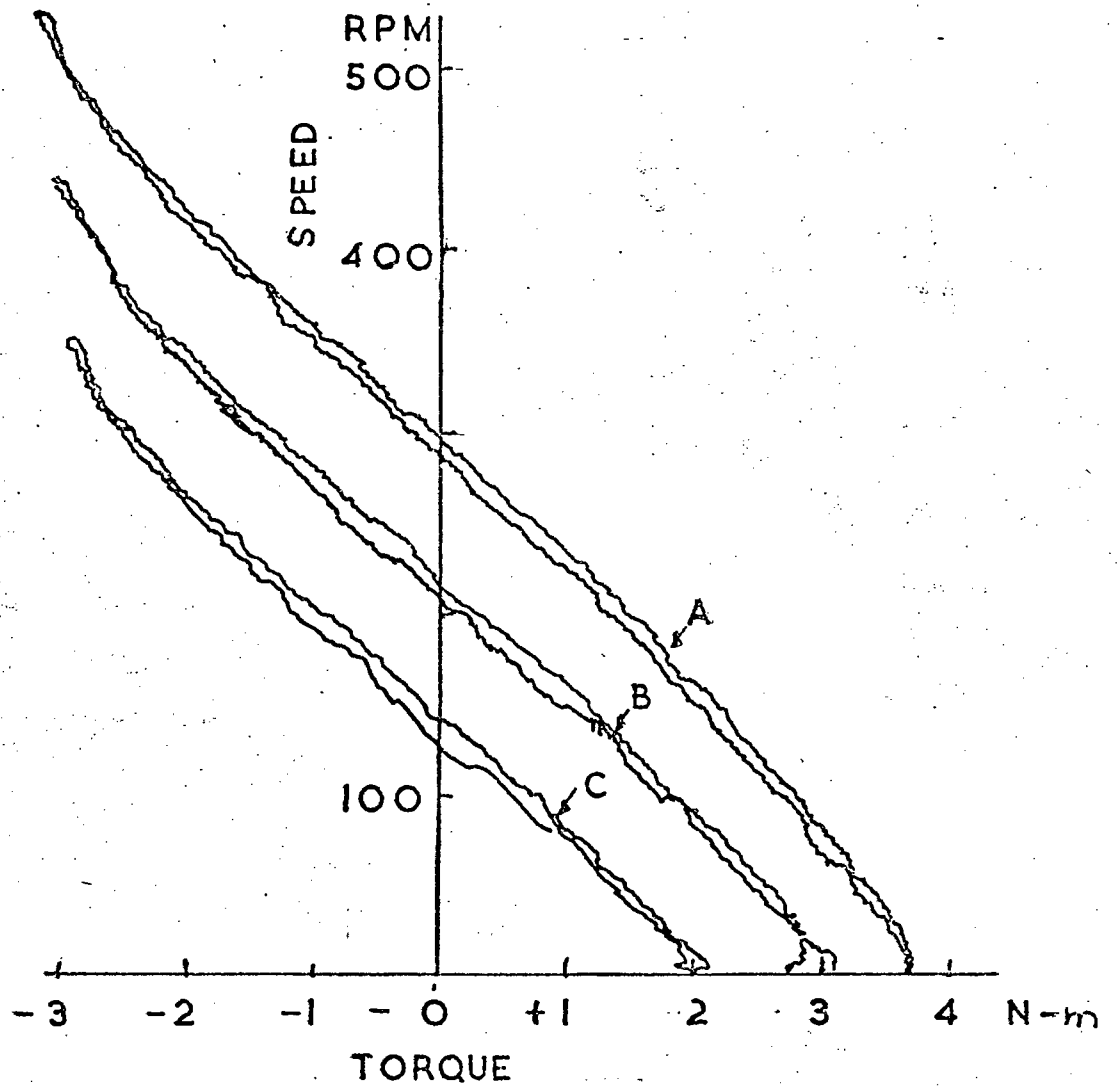
FIG. 6.12 LOSS TORQUE CURVE



FIELD CURRENT :-

A = 3,5A B = 2,63A C = 1,75A

FIG 6.13 EFFECT OF FIELD CURRENT
ON INPUT VOLTAGE
 NO VOLTAGE FEEDBACK



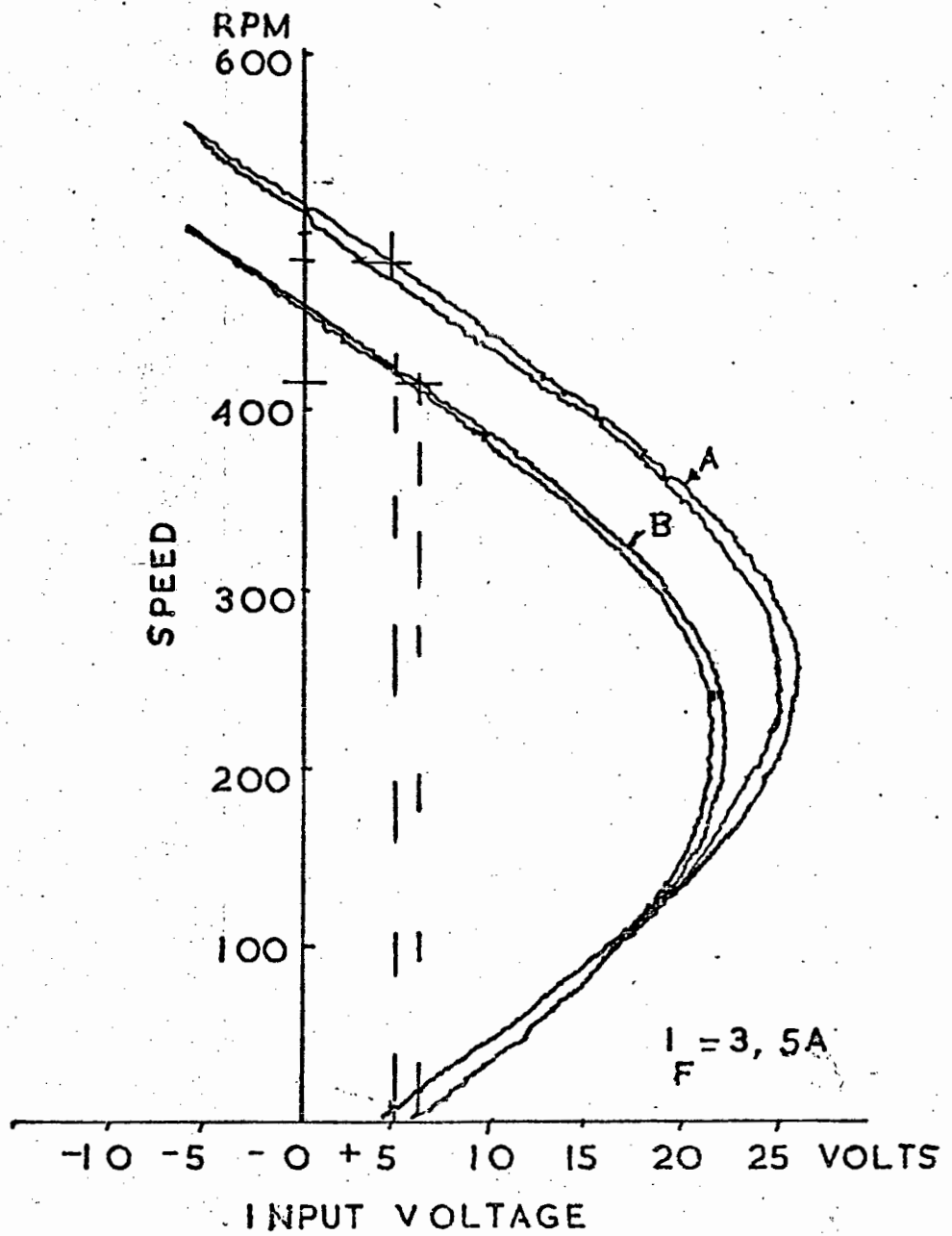
FIELD CURRENT :-

A=3.5A B=2.63A C=1.75A

FIG 6.14 EFFECT OF FIELD CURRENT

ON TORQUE

NO VOLTAGE FEEDBACK



INPUT CURRENT :-

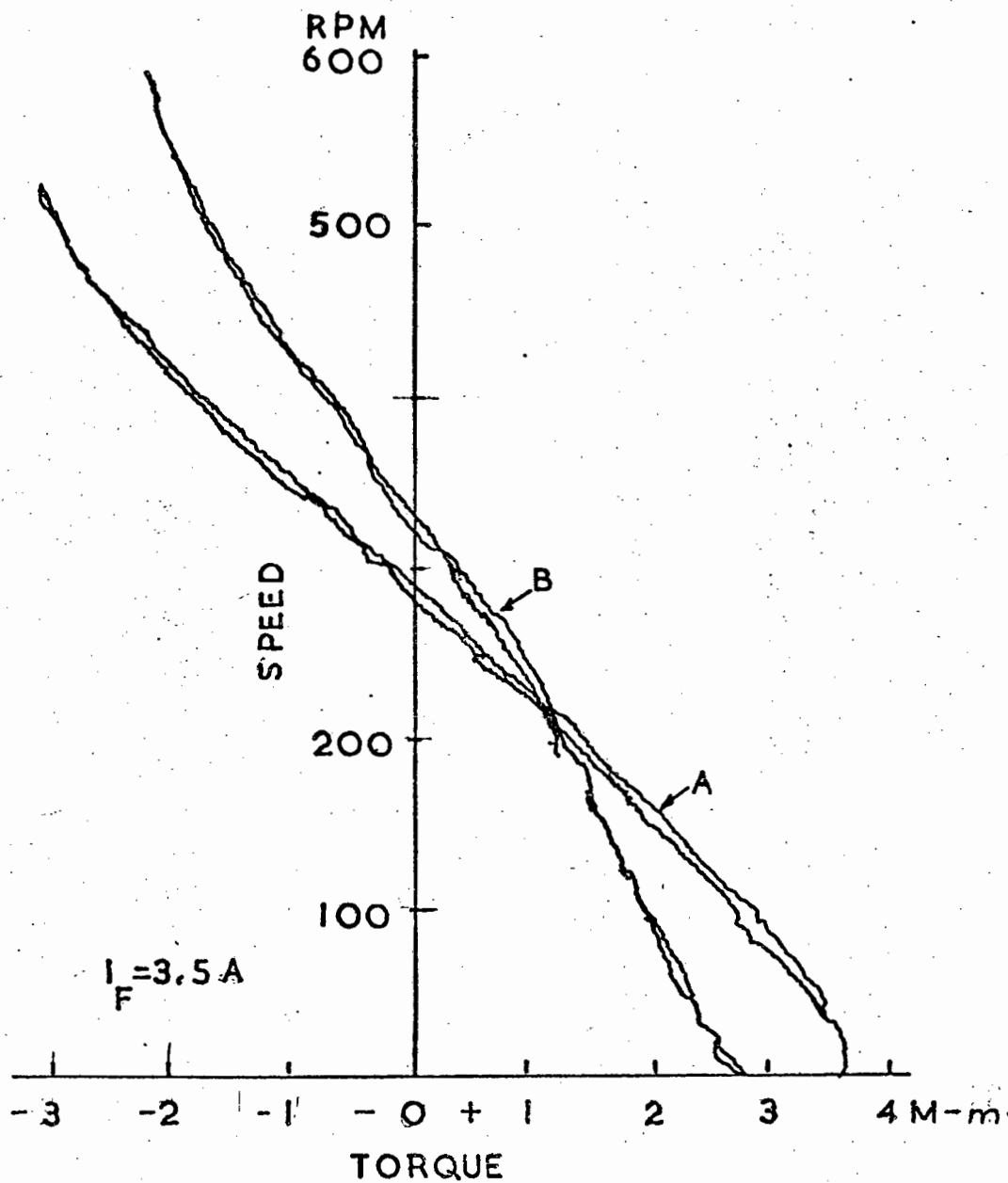
A = 4.5 A

B = 3.0 A

FIG 6.15 EFFECT OF INPUT CURRENT ON

INPUT VOLTAGE

NO VOLTAGE FEEDBACK



INPUT CURRENT :-

A = 4.5 A

B = 3.0 A

FIG 6.16 EFFECT OF INPUT CURRENT ON

TORQUE

NO VOLTAGE FEEDBACK

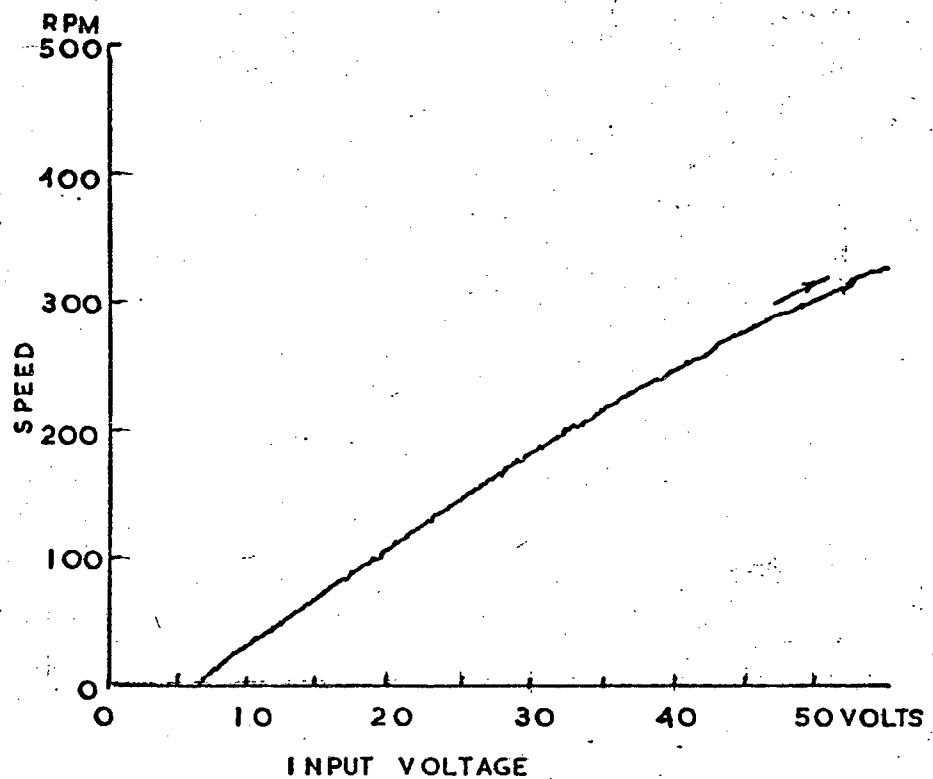


FIG 6.17 EFFECT OF EXCESSIVE VOLTAGE
FEEDBACK
INERTIA LOAD

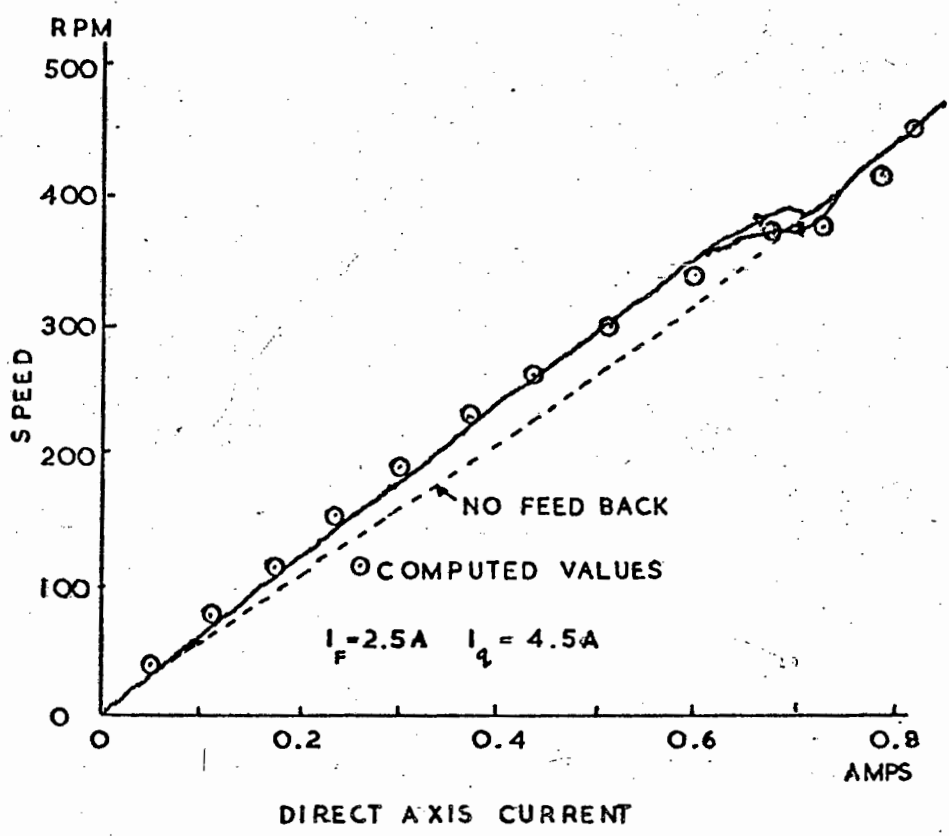


FIG 6.18 DIRECT-AXIS CURRENT WITH VOLTAGE FEED BACK

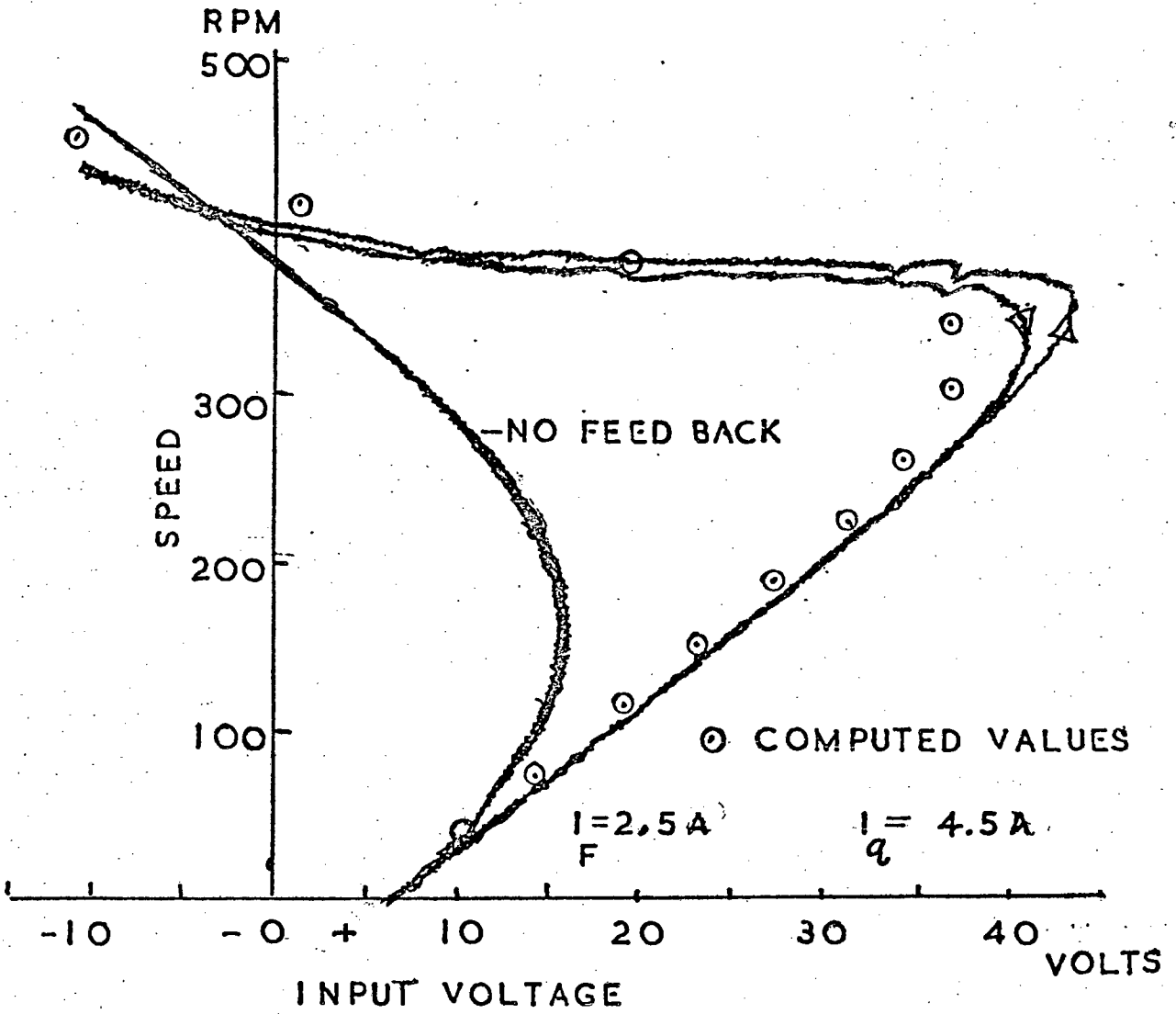


FIG 6.19. INPUT VOLTAGE WITH VOLTAGE

FEED BACK

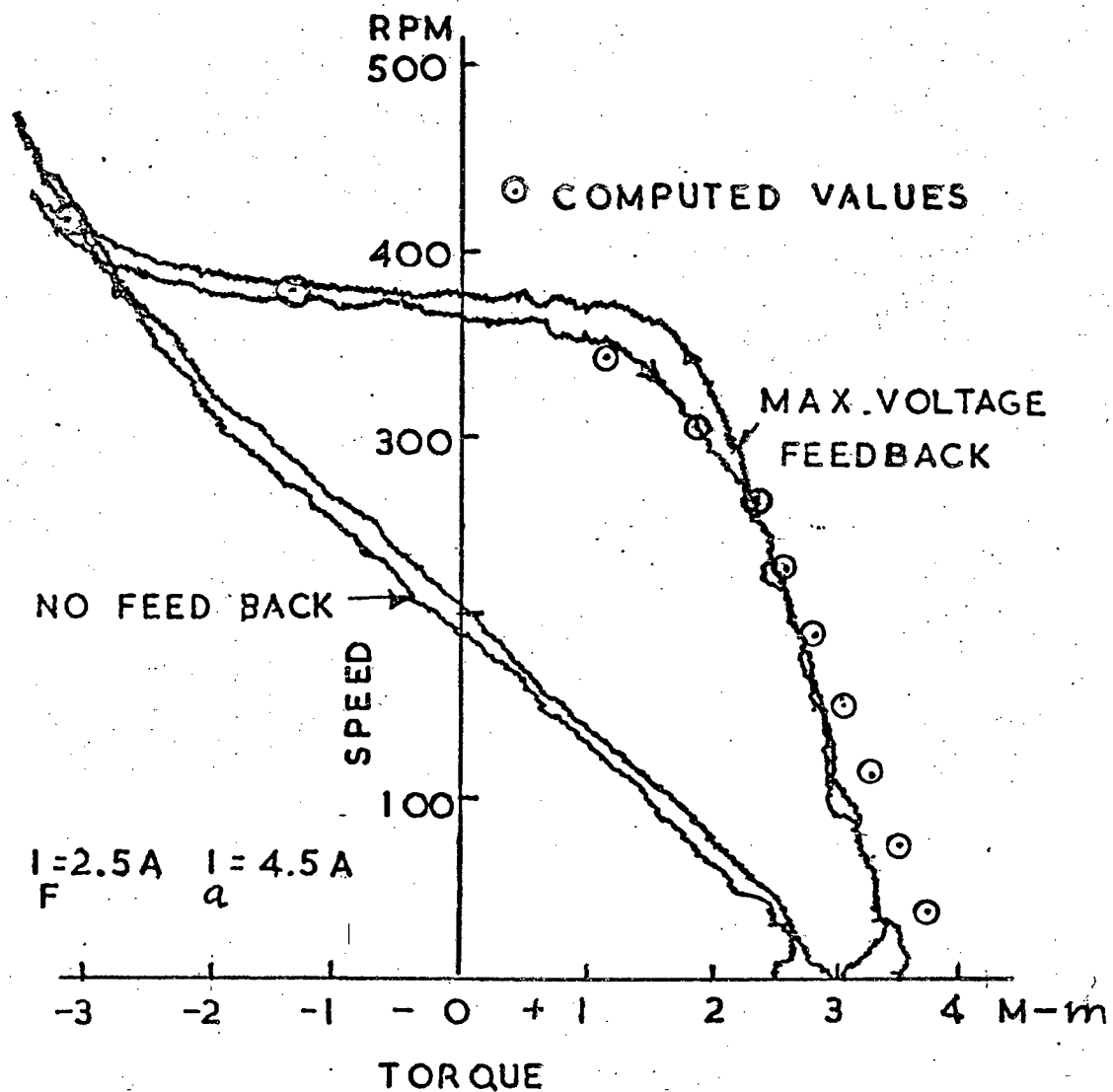


FIG 6.20 TORQUE WITH VOLTAGE FEED BACK

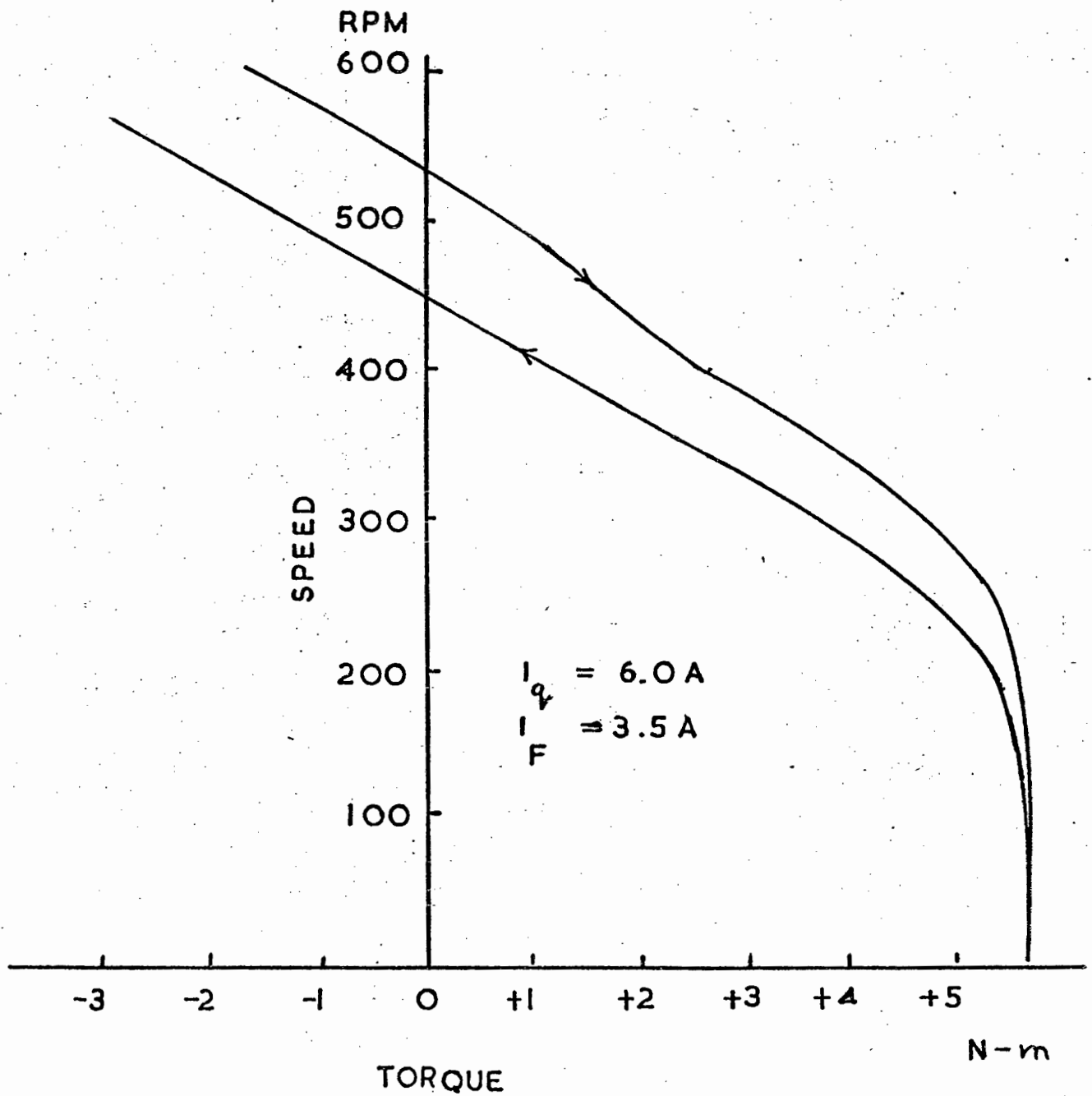


FIG 6.21: EFFECT OF SATURATION

NO VOLTAGE FEEDBACK

APPENDIX II : COMPUTER PROGRAMME MXF

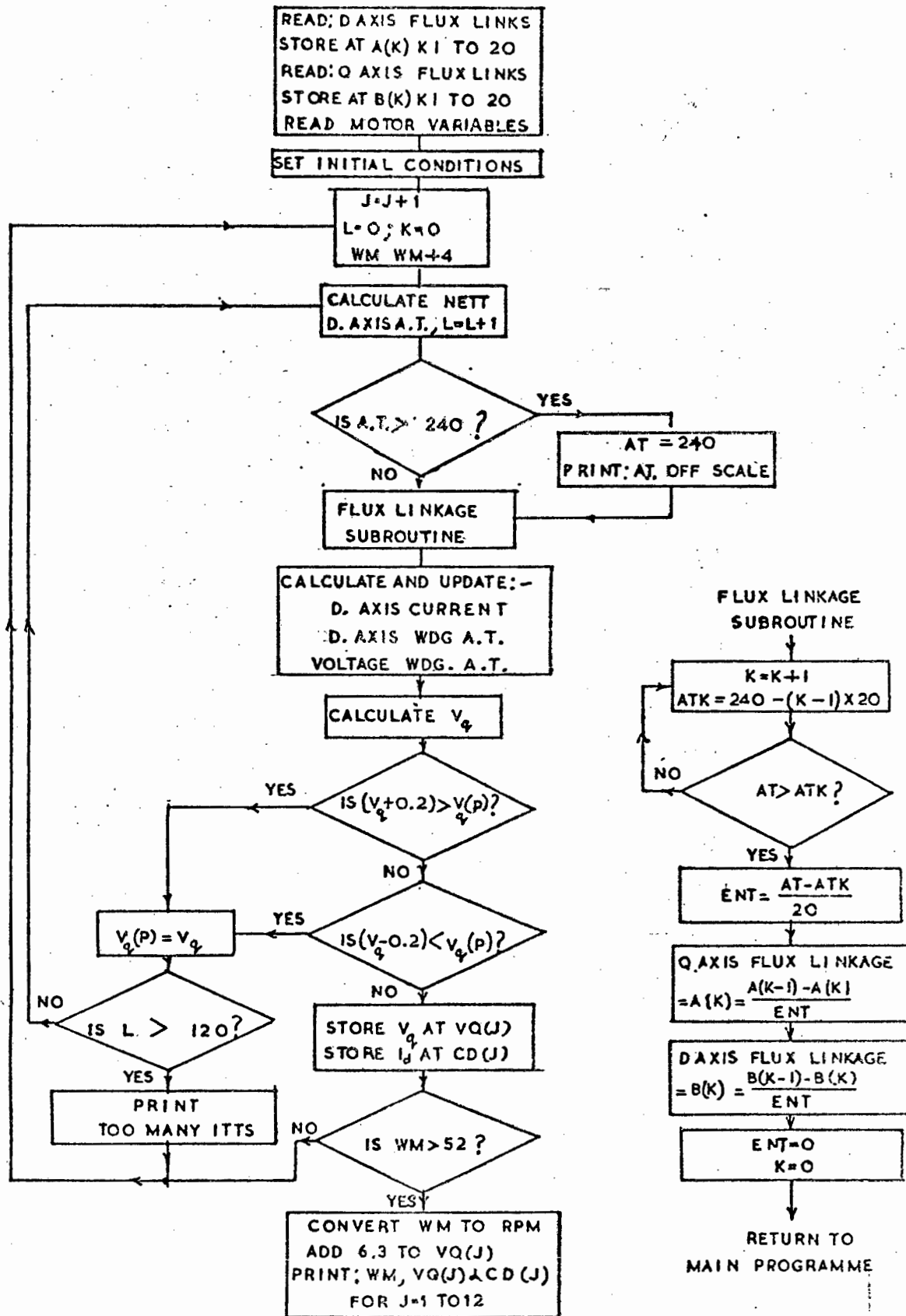


FIG A.1 FLOW CHART FOR PROGRAMME MFX