DASH 8-40C SPECIFIC FUEL CONSUMPTION

NOTCH	ENGINE RPM	NET TRACTION HORSEPOWER	FUEL LBS/HOUR
8	1050	3817	1359.7
8	995	3816	1348.0
7	995	3199	1141.8
6	995	2547	927.5
5	995	1909	723.8
4	888	1291	508.4
3	888	860	358.3
2	581	369	158.9
1	441	160	77.8
IDLE	441		25.8
LL IDLE	341		17.8
DB1	441		25.8
DB2	581		39.1
DB3	719		58.8
DB4	888		90.9

LOCOMOTIVE FEATURES:

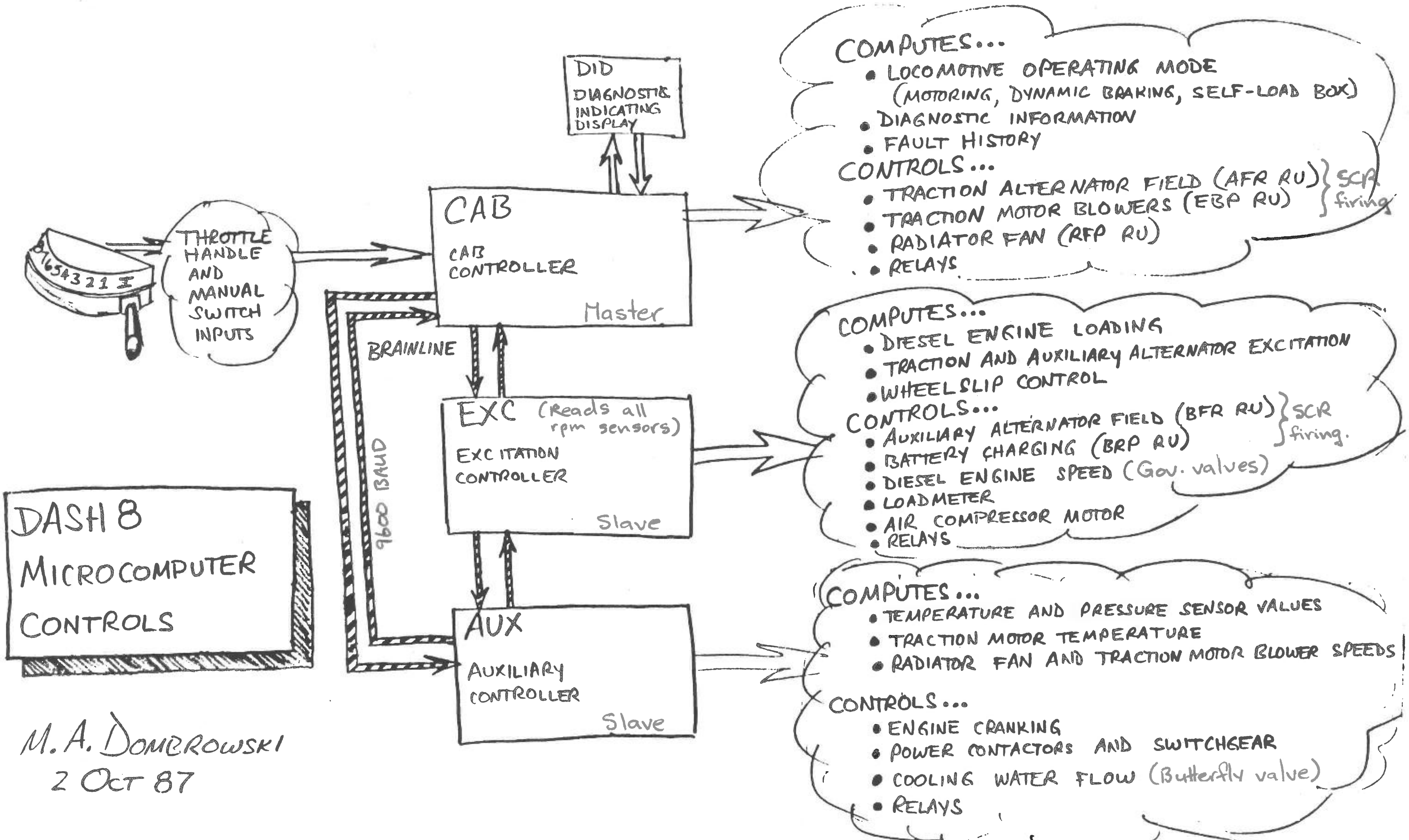
- o Motor driven auxiliaries
- o GE 1716 turbocharger with dual pipe exhaust manifold
- o Bryce injectors with Bryce single helix injection pumps
- o Based on 4100 BHP +2%, -1%

The above performance is the expected average for a typical locomotive at standard conditions. Individual locomotives may vary from the above by +/- 1 percent.

STANDARD CONDITIONS:

60 Degrees F. inlet air temperature
28.86 inches hg. barometric pressure
19350 btu/lb fuel high heat value
40 Miles/hour

NOTE: Net traction horsepower is horsepower out of the rectifiers.



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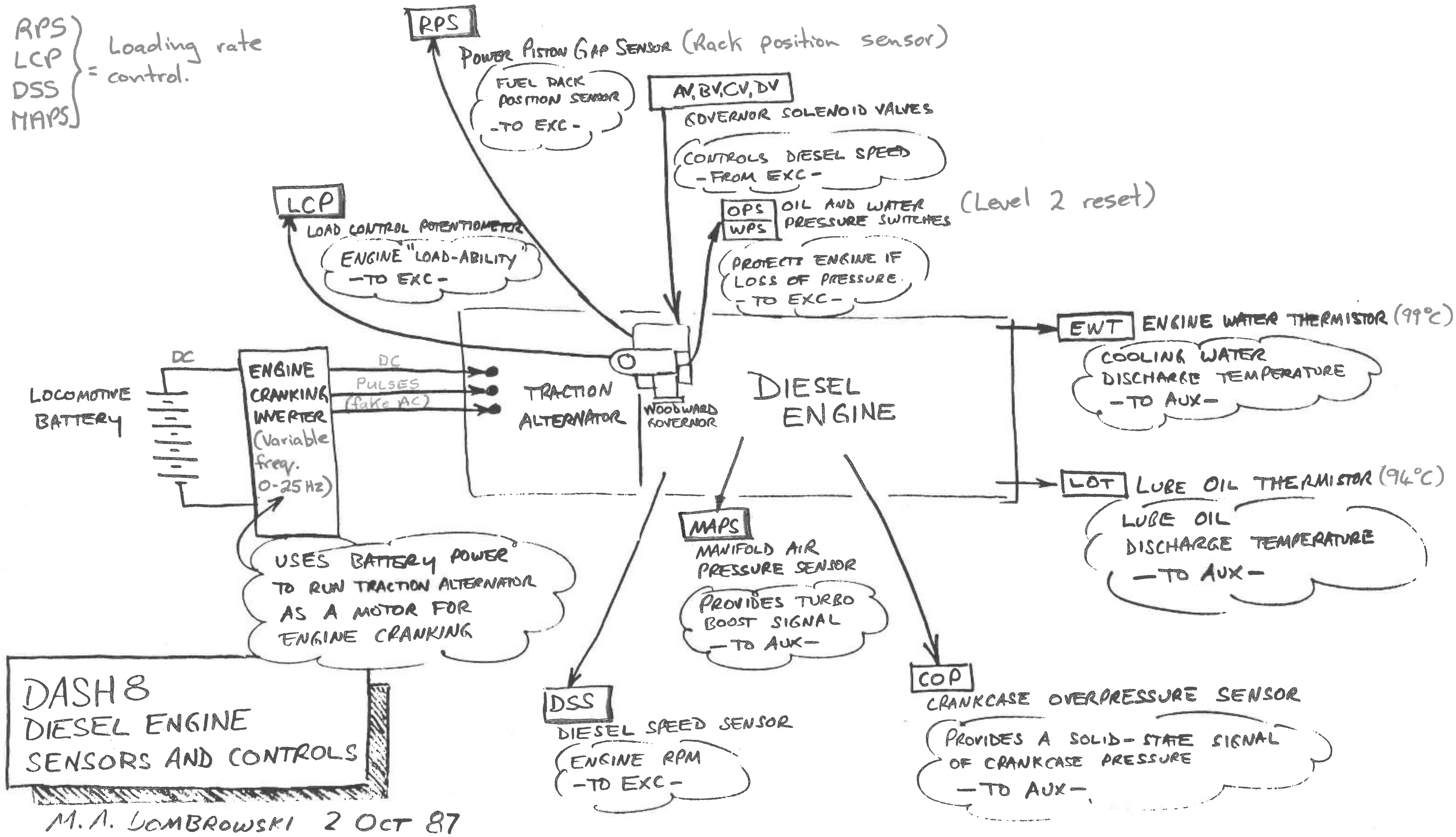
RPS LCP DSS MAPS = Loading rate control.
RPS
POWER PISTON GAP SENSOR (Rack position sensor)
FUEL RACK POSITION SENSOR -TO EXC-
AV, BV, CV, DV
GOVERNOR SOLENOID VALVES
CONTROLS DIESEL SPEED -FROM EXC-
LCP
LOAD CONTROL POTENTIOMETER
ENGINE "LOAD-ABILITY" -TO EXC-
OPS
WPS
OIL AND WATER PRESSURE SWITCHES
(Level 2 reset)
PROTECTS ENGINE IF LOSS OF PRESSURE -TO EXC-
EWT
ENGINE WATER THERMISTOR (99°C)
COOLING WATER DISCHARGE TEMPERATURE -TO AUX-
LOCOMOTIVE BATTERY
DC
ENGINE CRANKING INVERTER (Variable freq. 0-25 Hz)
DC PULSES (fake AC)
TRACTION ALTERNATOR
WOODWARD GOVERNOR
DIESEL ENGINE
LOT
LUBE OIL THERMISTOR (94°C)
LUBE OIL DISCHARGE TEMPERATURE -TO AUX-
USES BATTERY POWER TO RUN TRACTION ALTERNATOR AS A MOTOR FOR ENGINE CRANKING
MAPS
MANIFOLD AIR PRESSURE SENSOR
PROVIDES TURBO BOOST SIGNAL -TO AUX-
DSS
DIESEL SPEED SENSOR
ENGINE RPM -TO EXC-
COP
CRANKCASE OVERPRESSURE SENSOR
PROVIDES A SOLID-STATE SIGNAL OF CRANKCASE PRESSURE -TO AUX-
DASH 8 DIESEL ENGINE SENSORS AND CONTROLS
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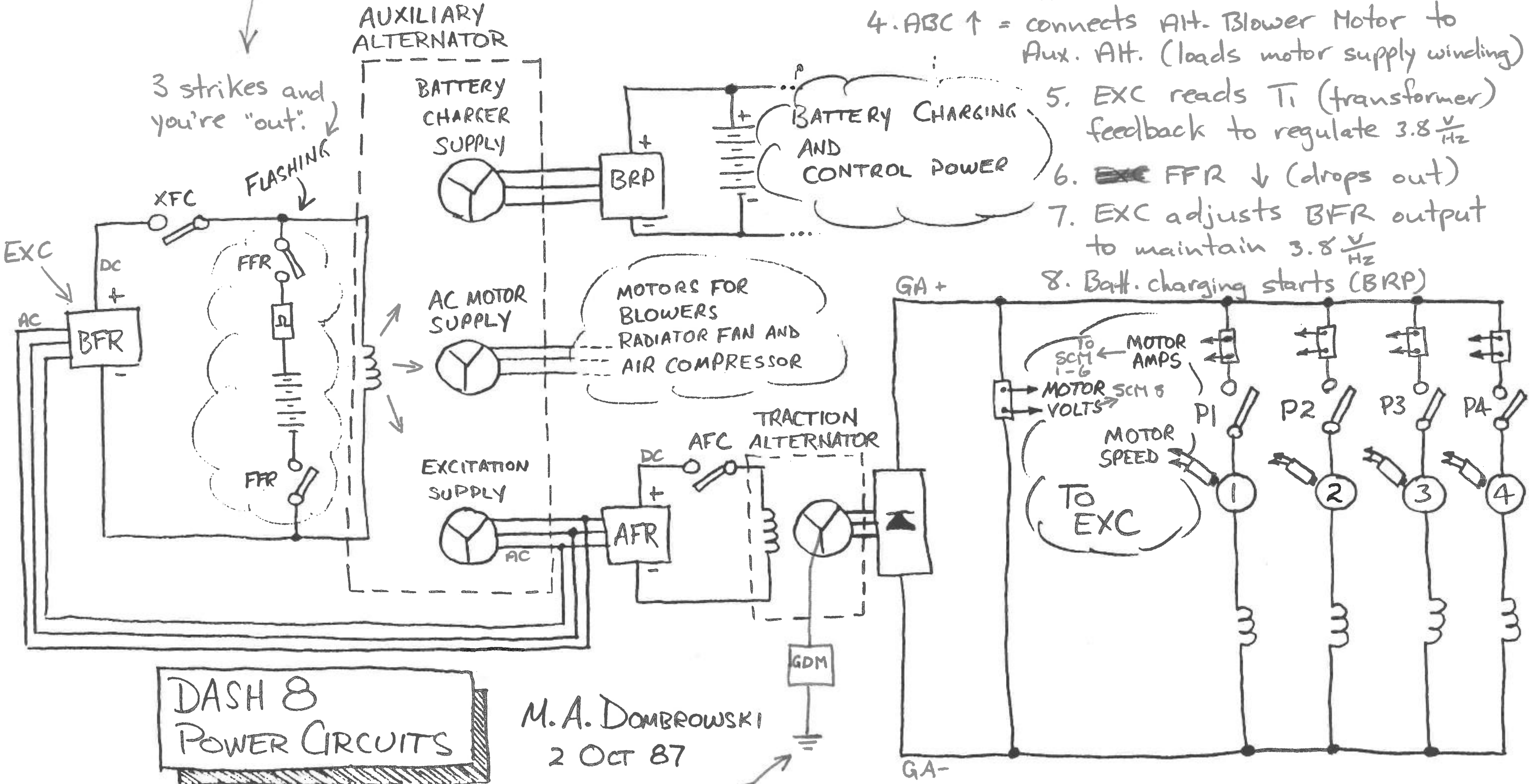
AUX. ALT. FIELD FLASHING

1. Eng. speed → 440 rpm
2. FFR ↑ = flash
3. XFC ↑ = apply BFR output to Aux. Alt. field.
4. ABC ↑ = connects Alt. Blower Motor to Aux. Alt. (loads motor supply winding)
5. EXC reads T_1 (transformer) feedback to regulate 3.8 $\frac{V}{Hz}$
6. ~~EXC~~ FFR ↓ (drops out)
7. EXC adjusts BFR output to maintain 3.8 $\frac{V}{Hz}$
8. Batt. charging starts (BRP)



DASH 8 POWER CIRCUITS

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Resets automatically from 3 FAULT logs within ½ hr. period = lockout then reset Level 2.

NB: SCM 7 reads motor field amps in D/B.

DASH 8 AUXILIARY AC MACHINES

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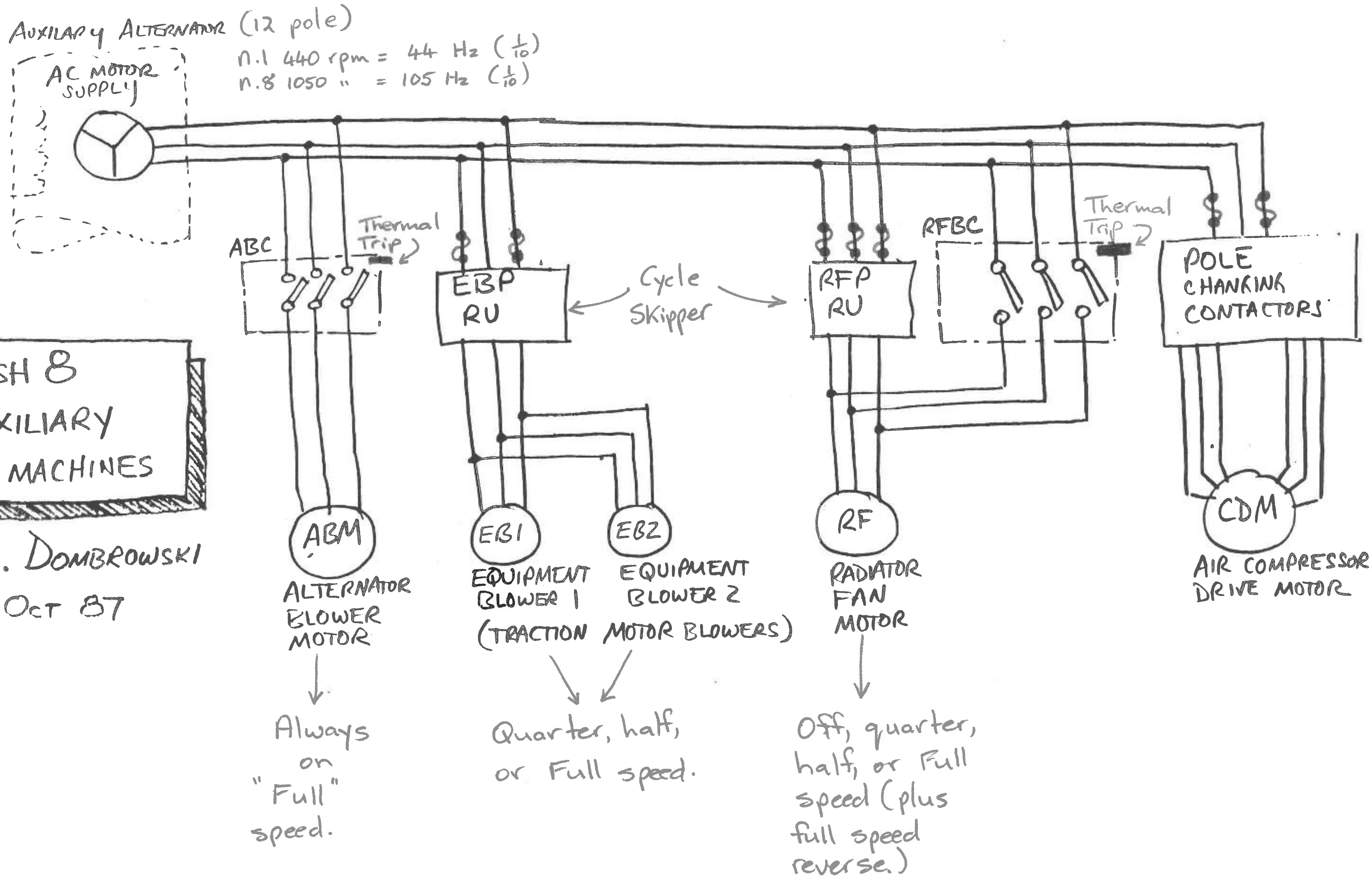


DASH 8 DIESEL ENGINE SPEEDS (RPM)

...WHEN STARTING ...

~~LOW LOW IDLE~~	~~270~~
LOW IDLE	340
IDLE	440
HI IDLE	580
NOTCH 1	440
NOTCH 2	580
NOTCH 3	~~725~~ 880
NOTCH 4	~~780~~ 880
NOTCH 5	880
NOTCH 6	880
NOTCH 7	1000
NOTCH 8	1050

"Quad 6" speed sched.

ENGINE SHUTDOWN (0 RPM)

↓

START ENGINE (340 RPM)
ABOUT 20 SECOND WAIT
TO STABILIZE ENGINE

↓

ENGINE SPEED GOES TO 440 RPM
START AUX ALTERNATOR
START BATTERY CHARGER

Aux. Alt. Field Flashing

↓

VERY COLD OIL?
(BELOW 90°F) 32°C

YES → IN IDLE : ENGINE SPEED IS 440 RPM
WHEN THROTTLED UP:
NOTCH 1 LOAD AND 440 RPM ONLY

Protects Diesel Engine

NO ↓

COLD OIL ?
(BELOW 140°F) 60°C
OR
COOL WATER
(BELOW 150°F) 65°C

YES → IN IDLE :ENGINE SPEED IS 580 RPM
WHEN THROTTLED UP:
LOAD AND SPEED FOLLOW THROTTLE
TO A MAXIMUM OF NOTCH #2

HI Idle Warms engine

NO ↓

WITH OIL ABOVE 140°F (60°C)
AND WATER ABOVE 150°F (65°C)

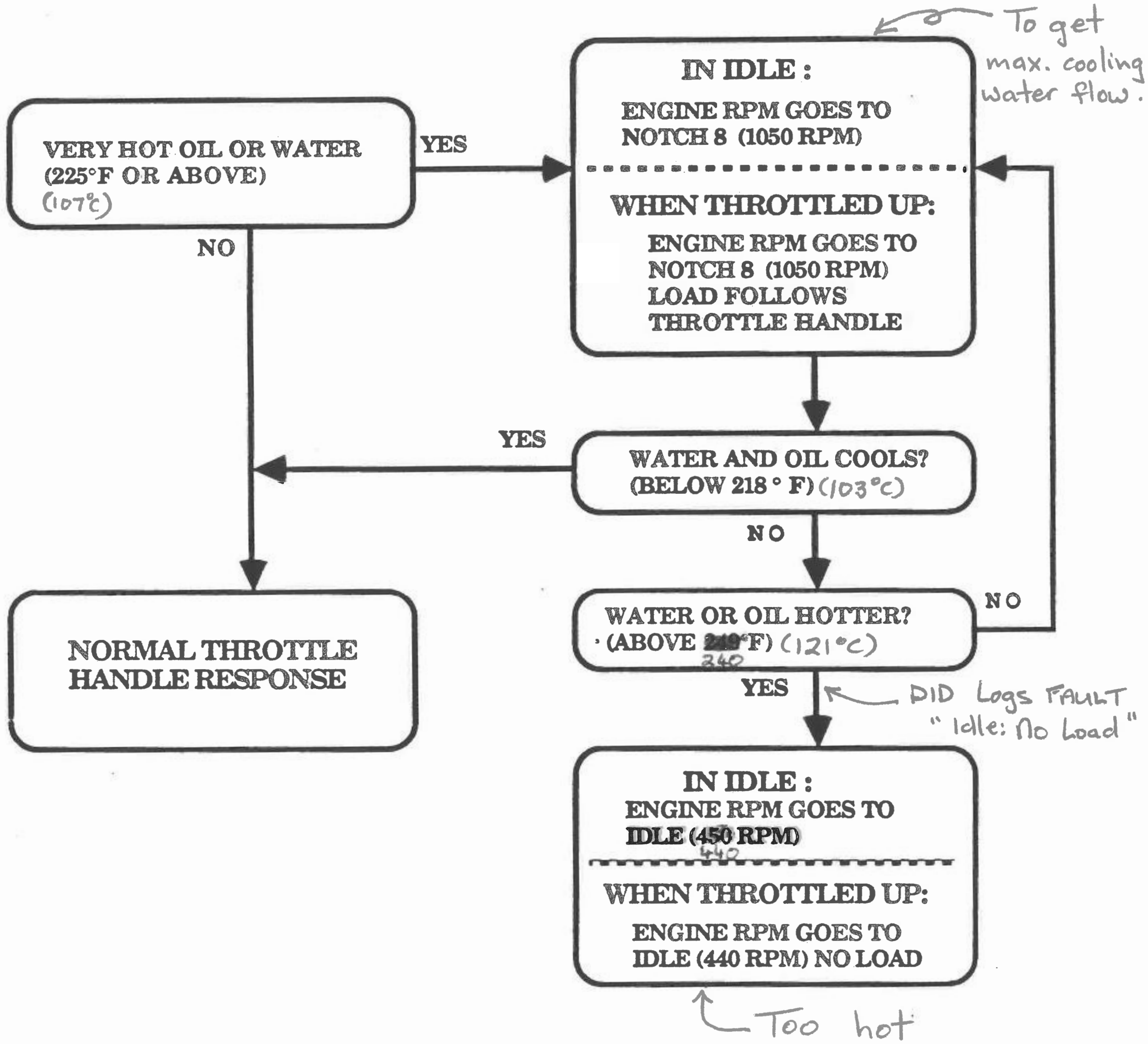
IN IDLE: ENGINE SPEED IS 440 RPM
WHEN THROTTLED UP:
LOAD & SPEED FOLLOW THROTTLE
(NOTCH 1 THRU 8)

Normal Throttle Response

MAD/CSI
30 JULY 87

DASH 8 DIESEL ENGINE SPEEDS (RPM)

... HOT ENGINE ... (TOO HOT !)

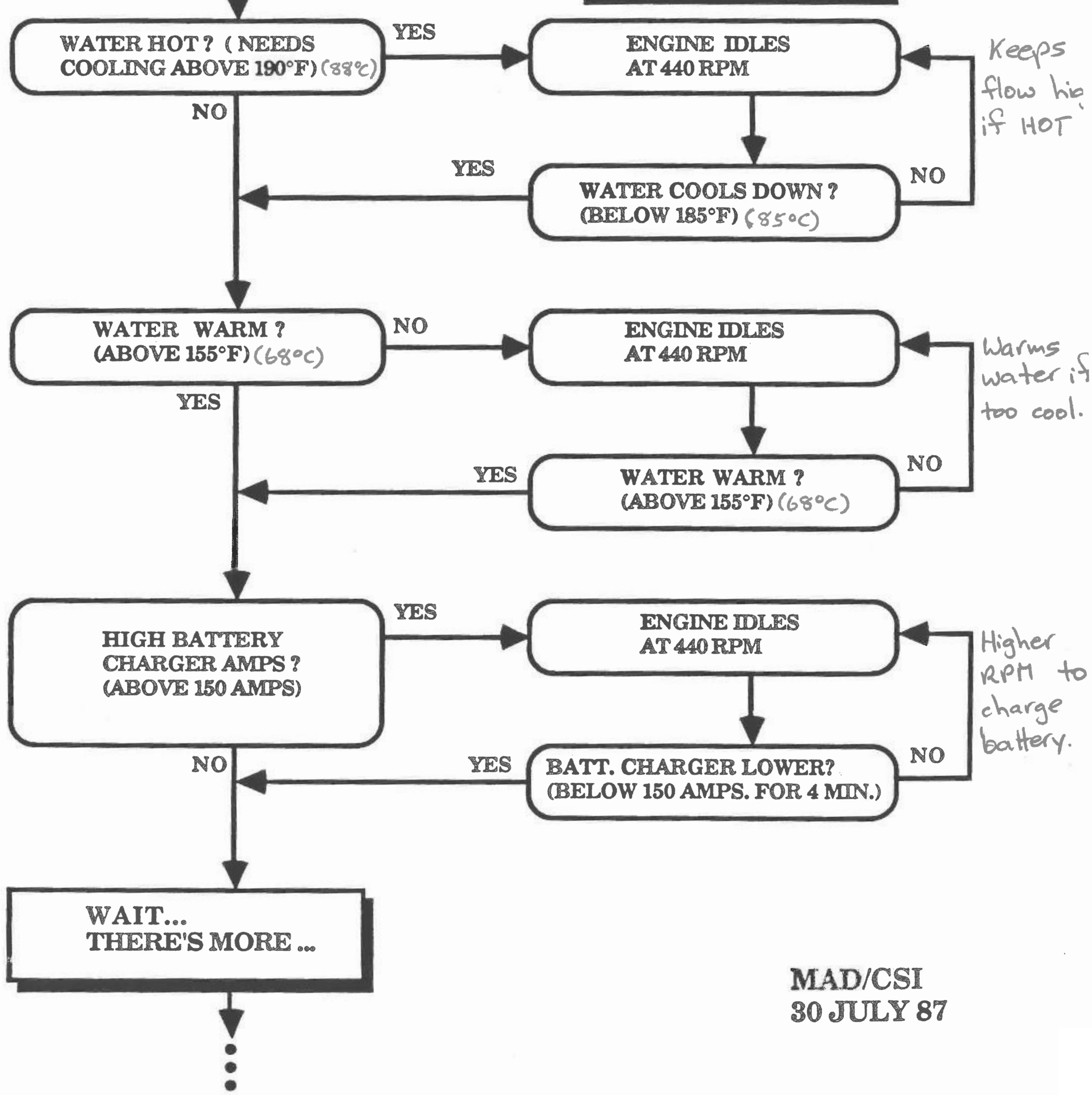


MAD/CSI
30 JULY 87

DASH 8 DIESEL ENGINE SPEEDS (RPM)

... THE IDLES ... (PAGE 1)

~~LOW LOW IDLE~~	~~270~~
LOW IDLE	340
IDLE	440
HI IDLE	580

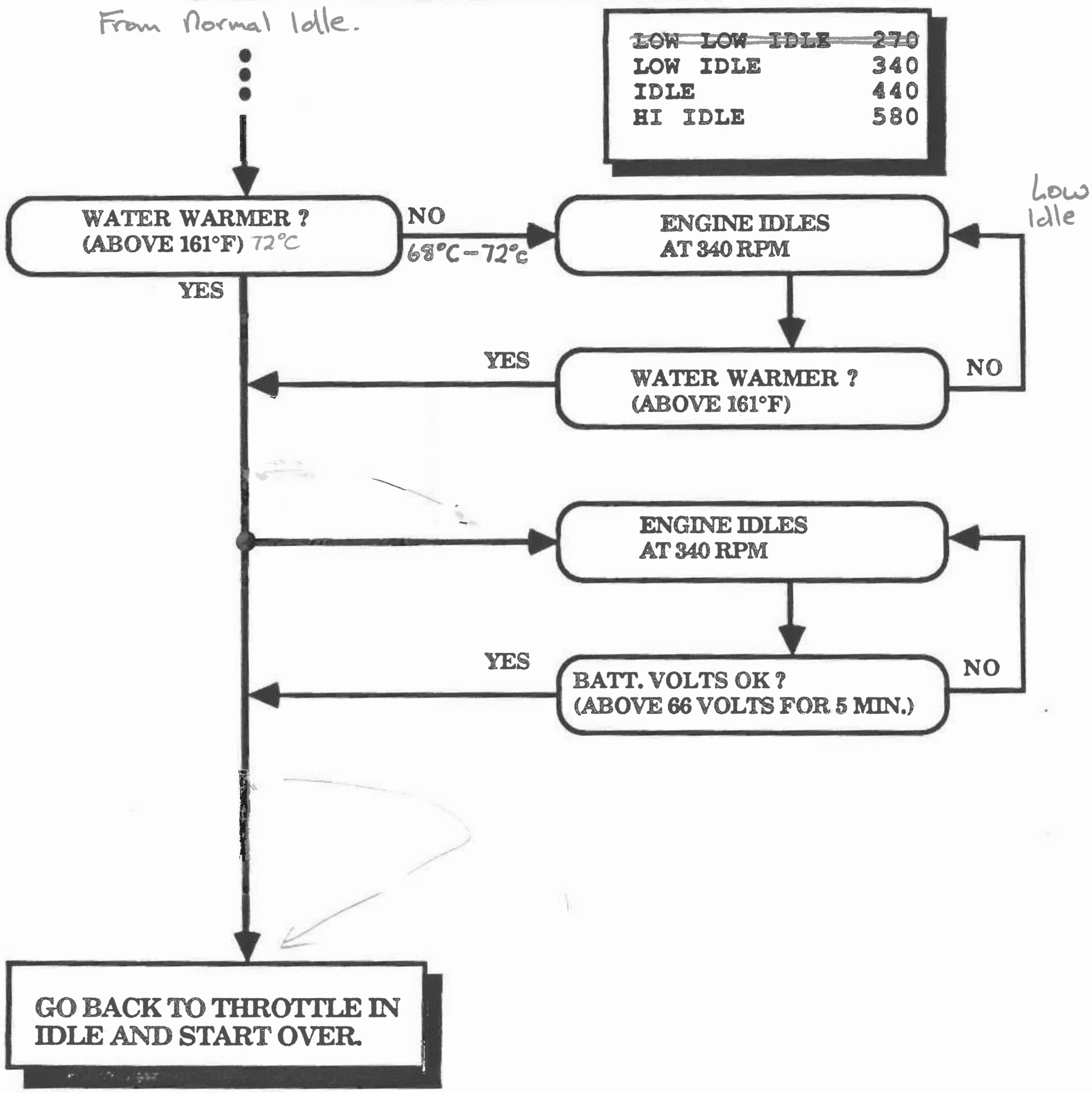


MAD/CSI
30 JULY 87

DASH 8 DIESEL ENGINE SPEEDS (RPM)

... THE IDLES ... (PAGE 2)

~~LOW LOW IDLE~~	~~270~~
LOW IDLE	340
IDLE	440
HI IDLE	580

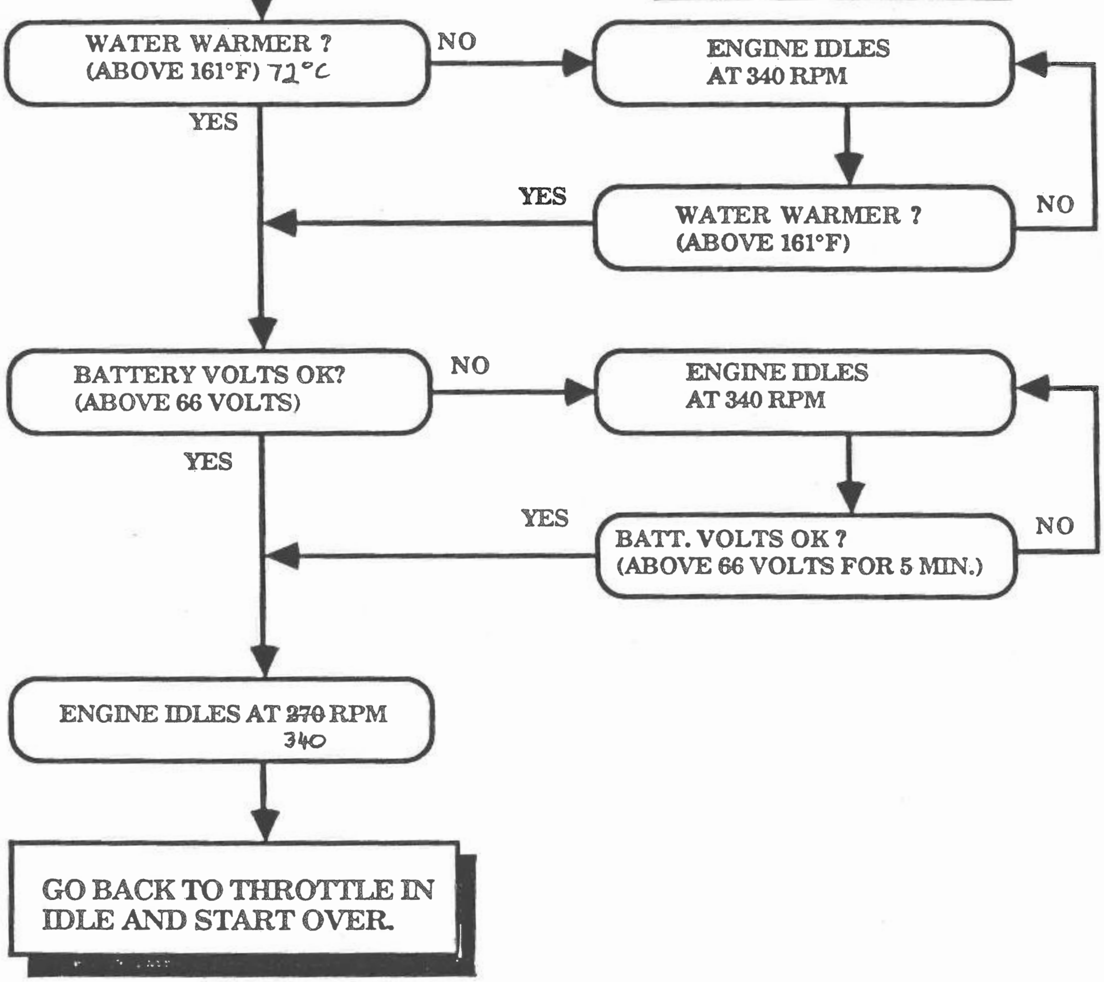


MAD/CSI
30 JULY 87

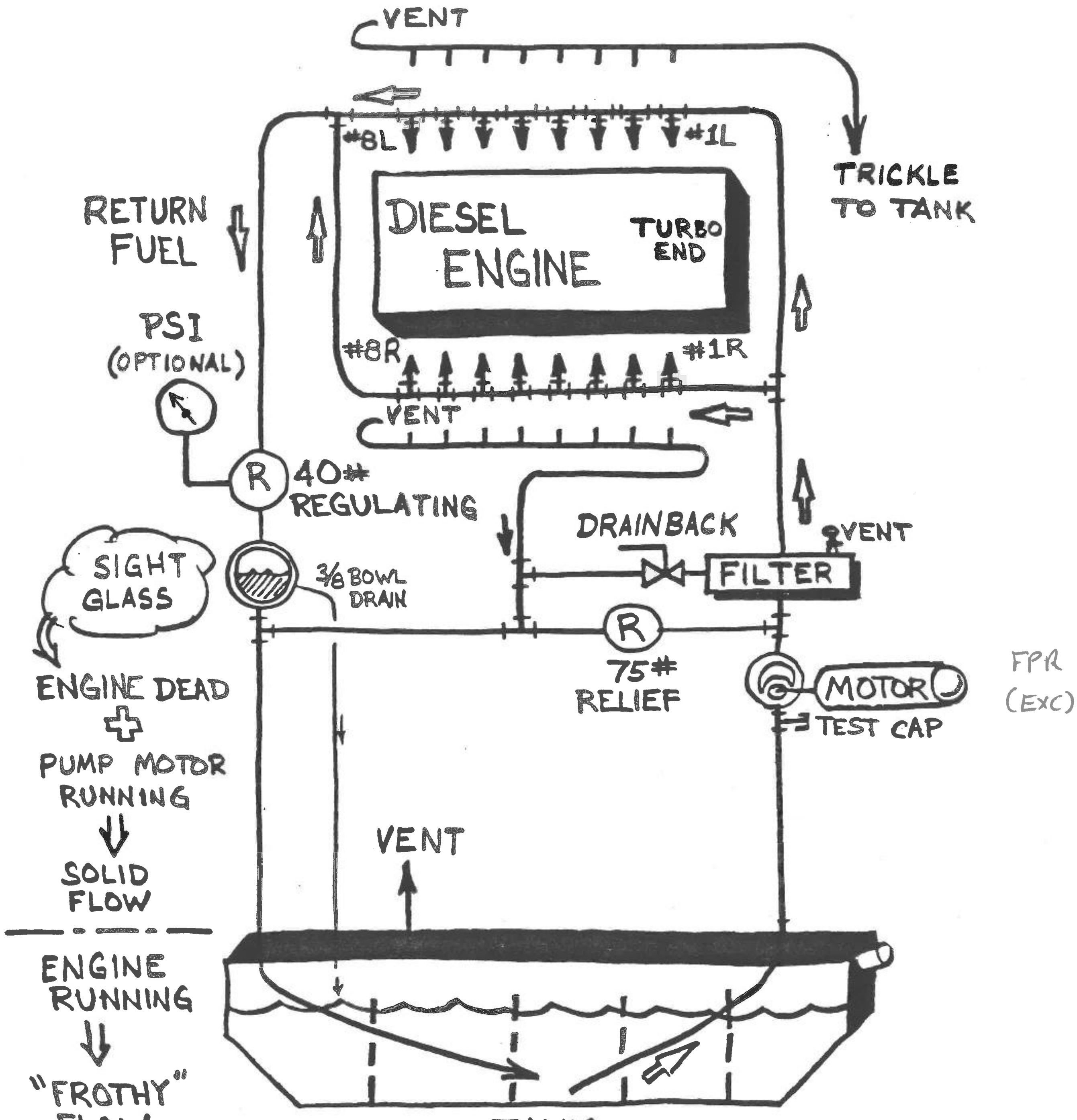
DASH 8 DIESEL ENGINE SPEEDS (RPM)

... THE IDLES ... (PAGE 2)

LOW LOW IDLE	270
LOW IDLE	340
IDLE	440
HI IDLE	580

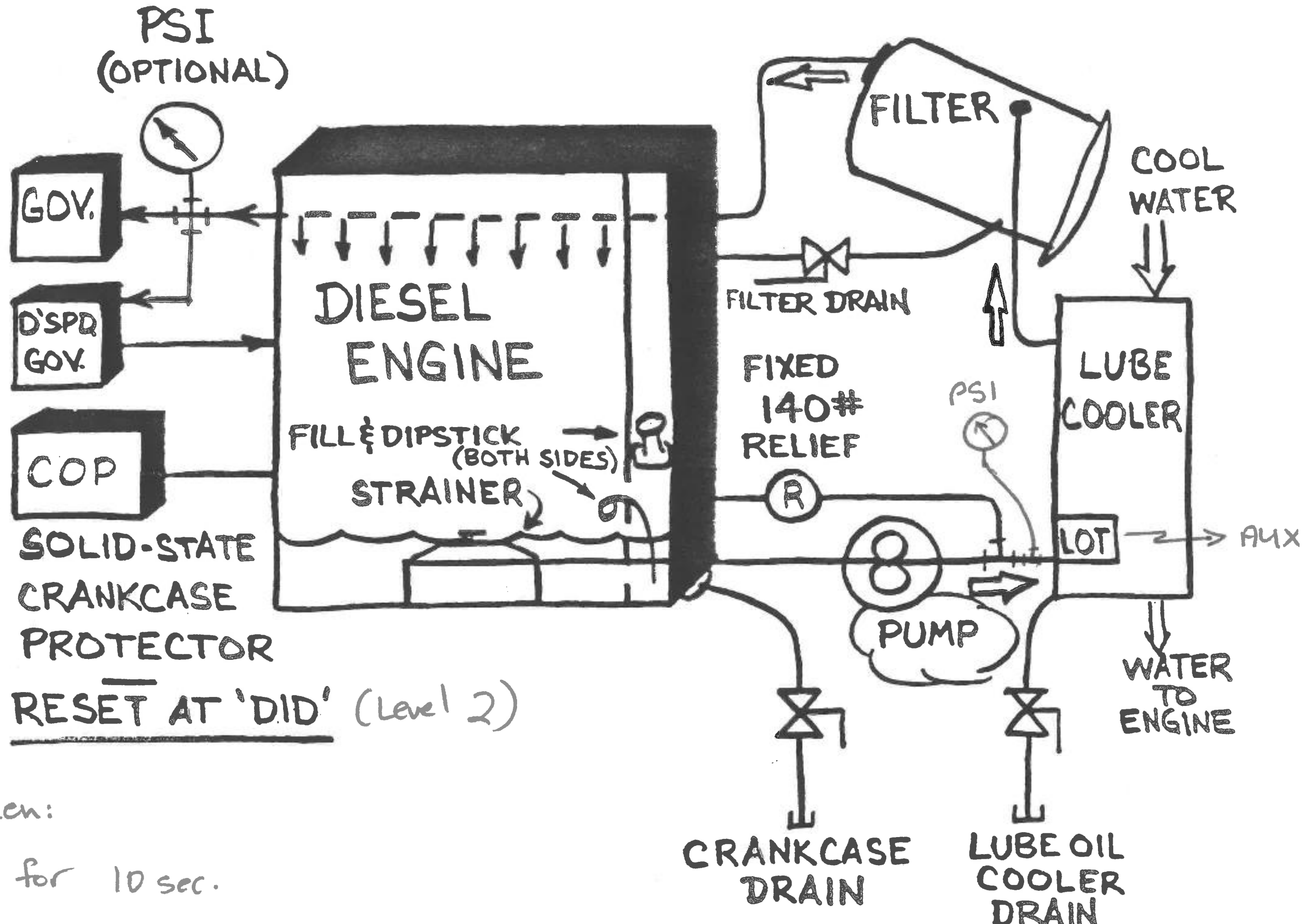


MAD/CSI
30 JULY 87



'87 DASH 8 FUEL

MAD
30 JULY '87



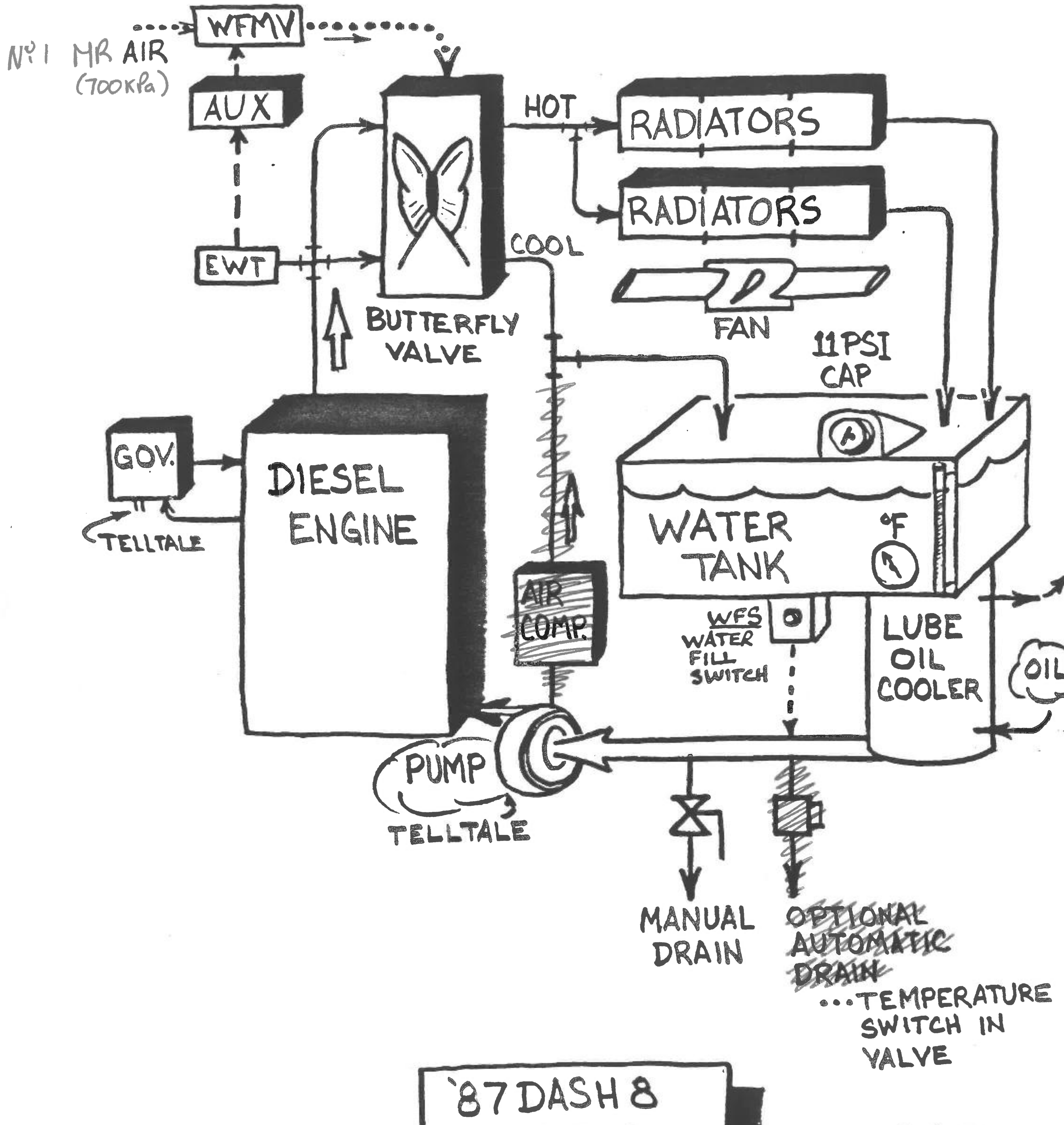
Trips when:

1) 2" H_2O for 10 sec.

2) 10" " " 1 sec.

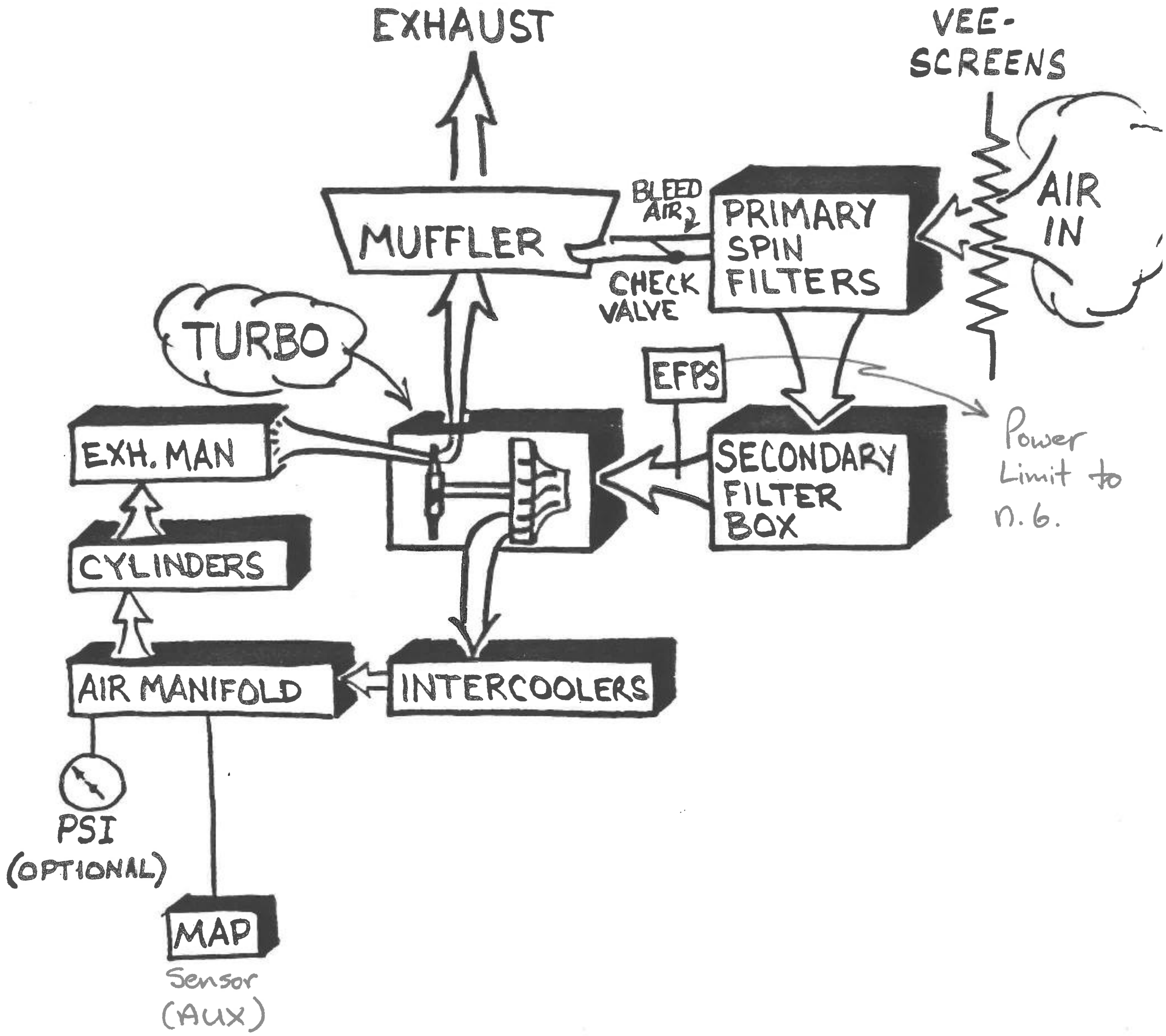
'87 DASH 8
LUBE

MAD
30 JULY '87



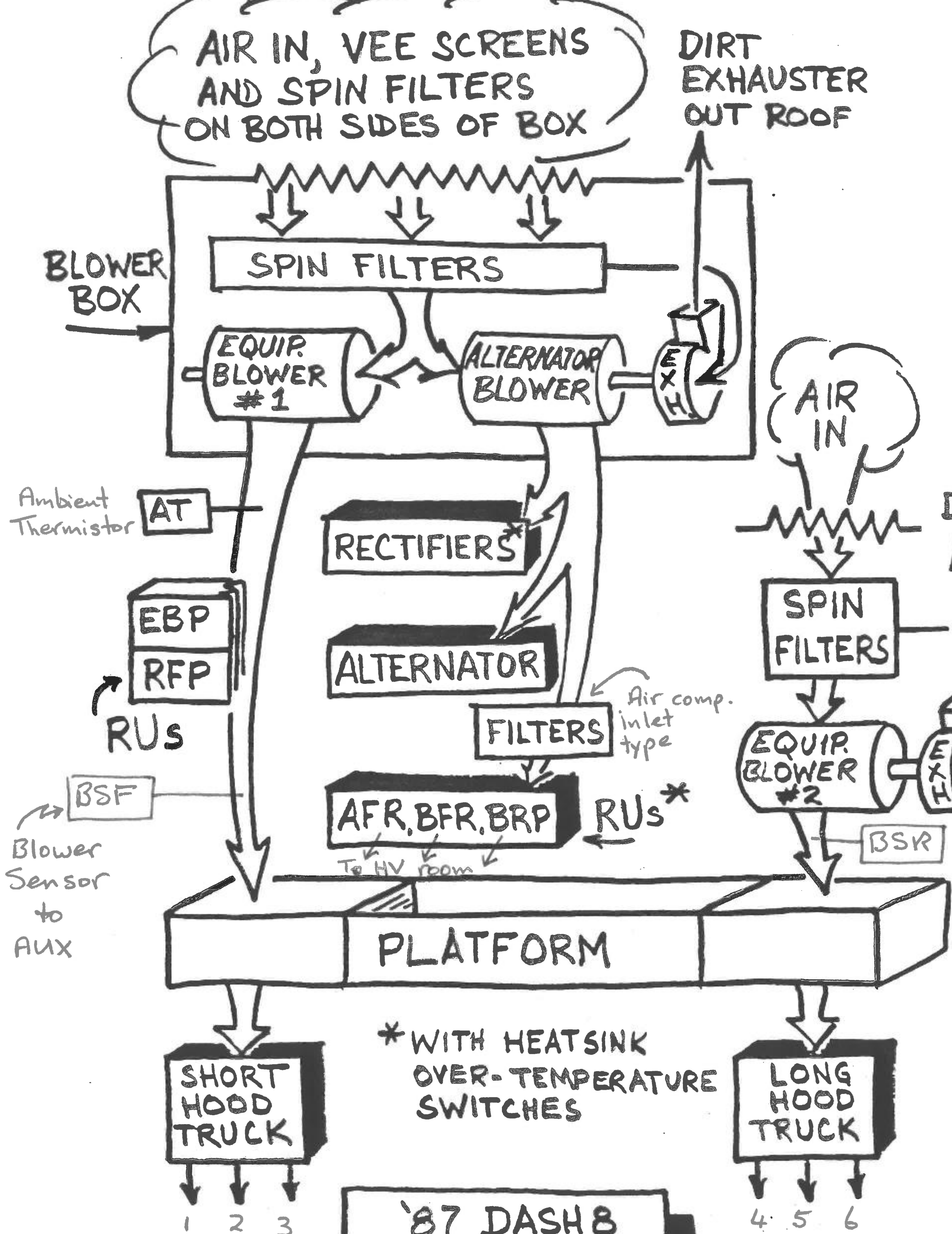
'87 DASH 8
WATER

MAD
31 JULY '87



'87 DASH 8
ENGINE AIR

MAD
03 JULY '87



'87 DASH 8 EQUIPMENT COOLING AIR

MAD
31 JULY '87

DASH 8 CRANKING:

(WOULD YOU BELIEVE... A-C BATTERIES?!)

(3 STRIKES ... AND YOU'RE OUT!)

IF... THE ENGINE WON'T START... HOLD THE ENGINE START SWITCH IN "START" LONG ENOUGH FOR THE COMPUTER TO TRY THREE TIMES, THEN LOG THE APPROPRIATE FAULT.

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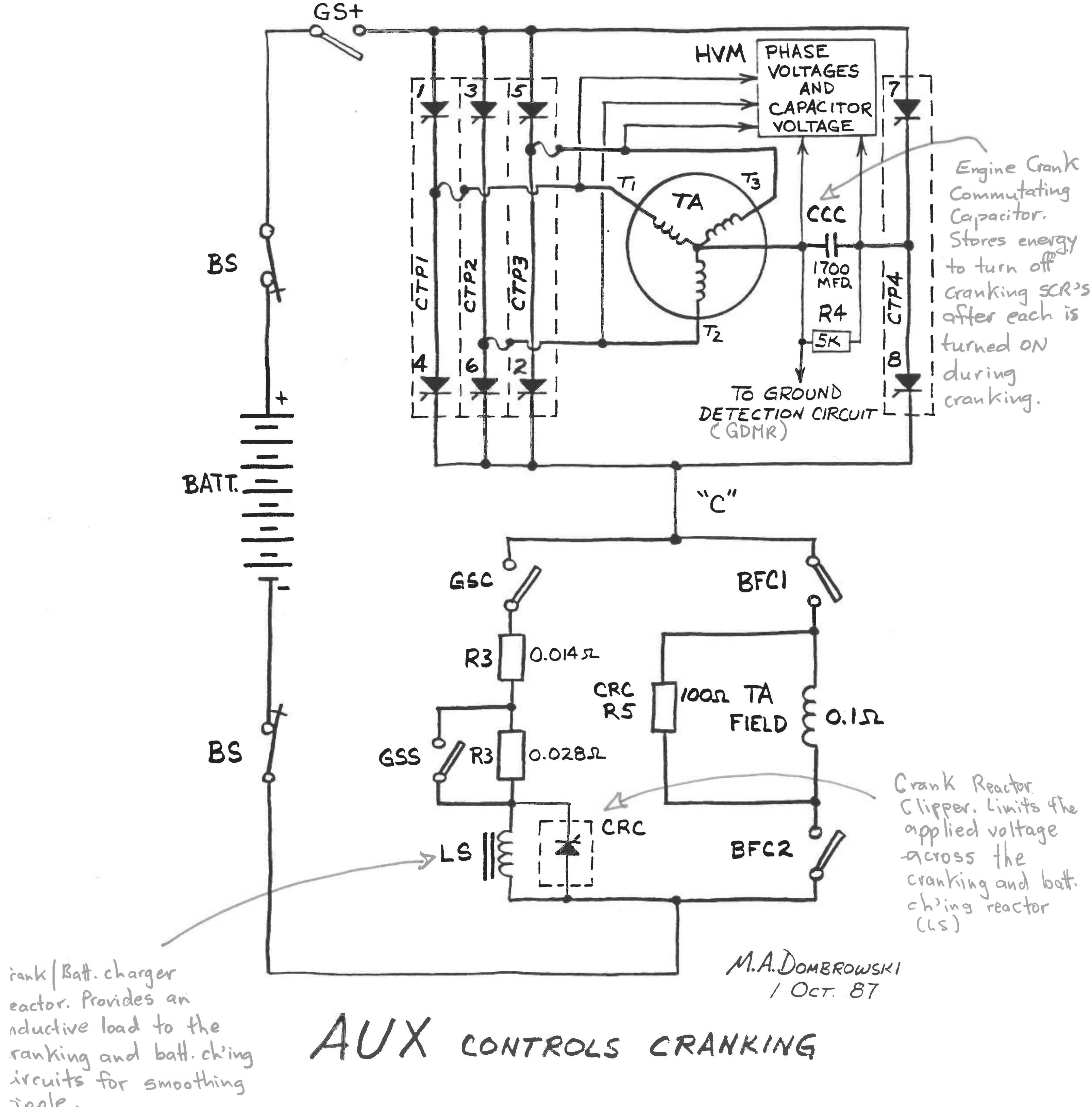
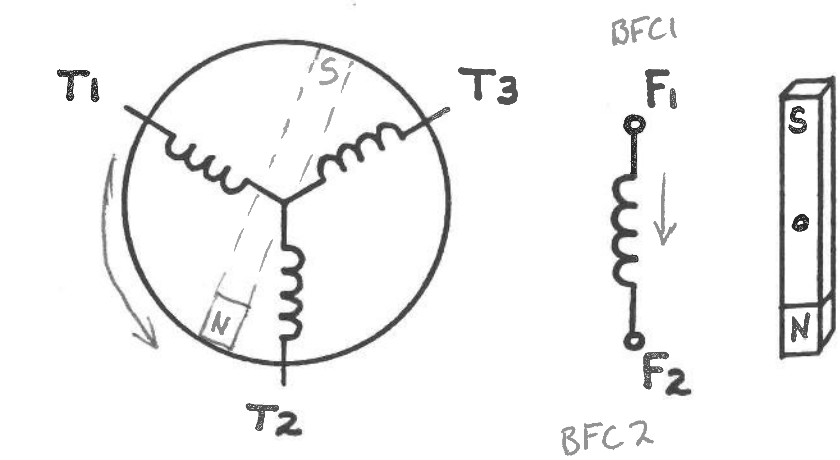
1 OCT. 87

DASH8 CRANKING HARDWARE

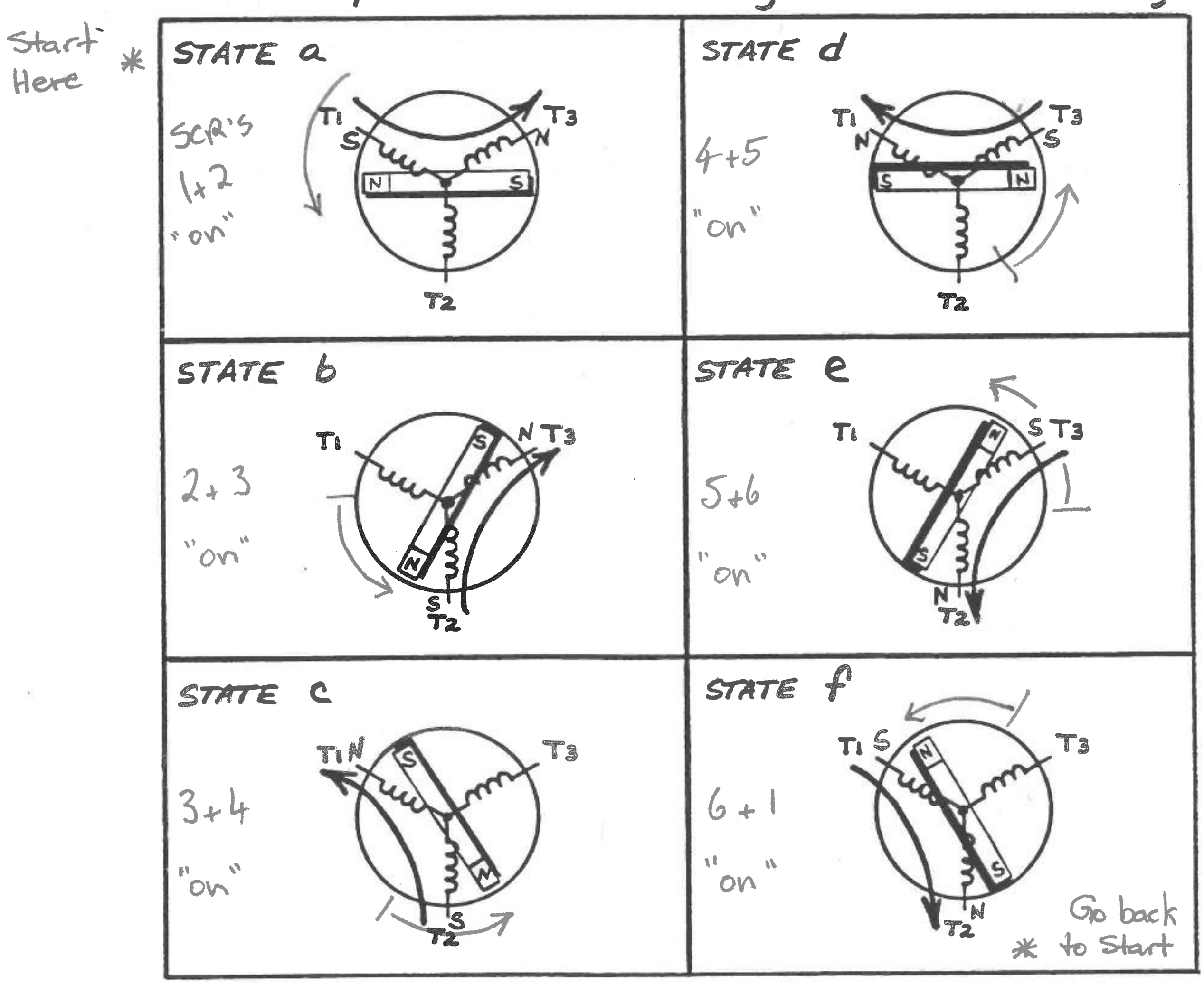


AUX CONTROLS CRANKING

DASH 8 CRANKING – WHAT WE'LL DO...



THERE ARE SIX POSSIBLE WAYS
to pass current through the stator windings:



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DASH 8 CRANKING - SEQUENCE STEPS...

A. PRIME the fuel system

- Engine Start switch to "PRIME"
  (10 sec. drop-out delay on FPR)

B. START engine cranking

- Engine Start switch to "START"

1) CONTACTOR CHECK - Pick up all 5 cranking contactors.
   (GS+, GSC, GSS, BFC1, BFC2)

2) CAPACITOR RING-UP
   64V battery → 600+V on CCC

About 3 secs.

3) ROTOR POSITION CHECK
   "SNAPSHOT"
   (Finds where rotor is "parked")

4) STATOR FIRING SEQUENCE
   "TORQUE"

About another 3 secs

5) FIELD SHUNTING
   GSS only
   "TRANSITION"
   (Maintain pull on rotor)

6) ENGINE STARTING AND CRANKER DROP-OUT.
   (approx 200 rpm)

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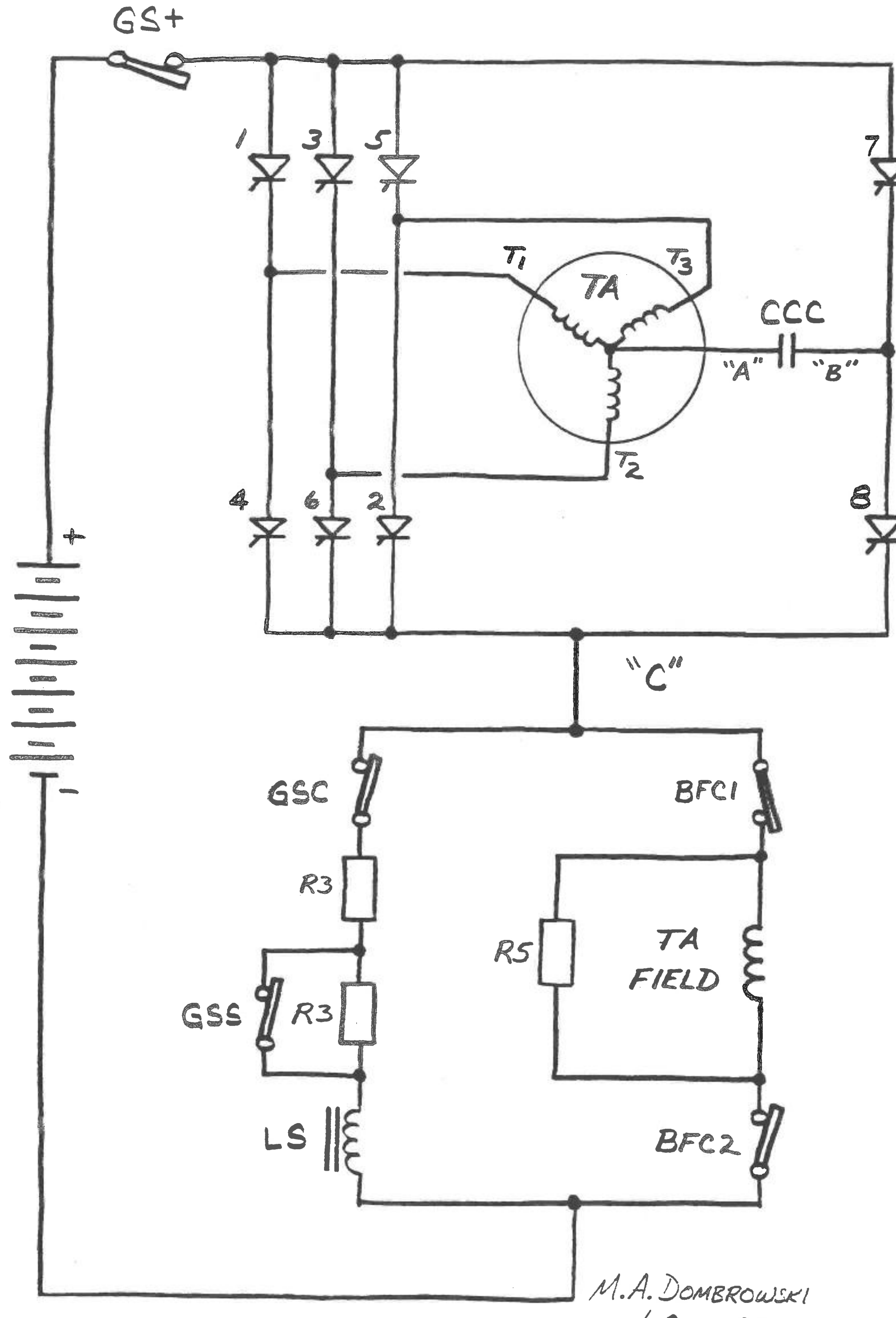

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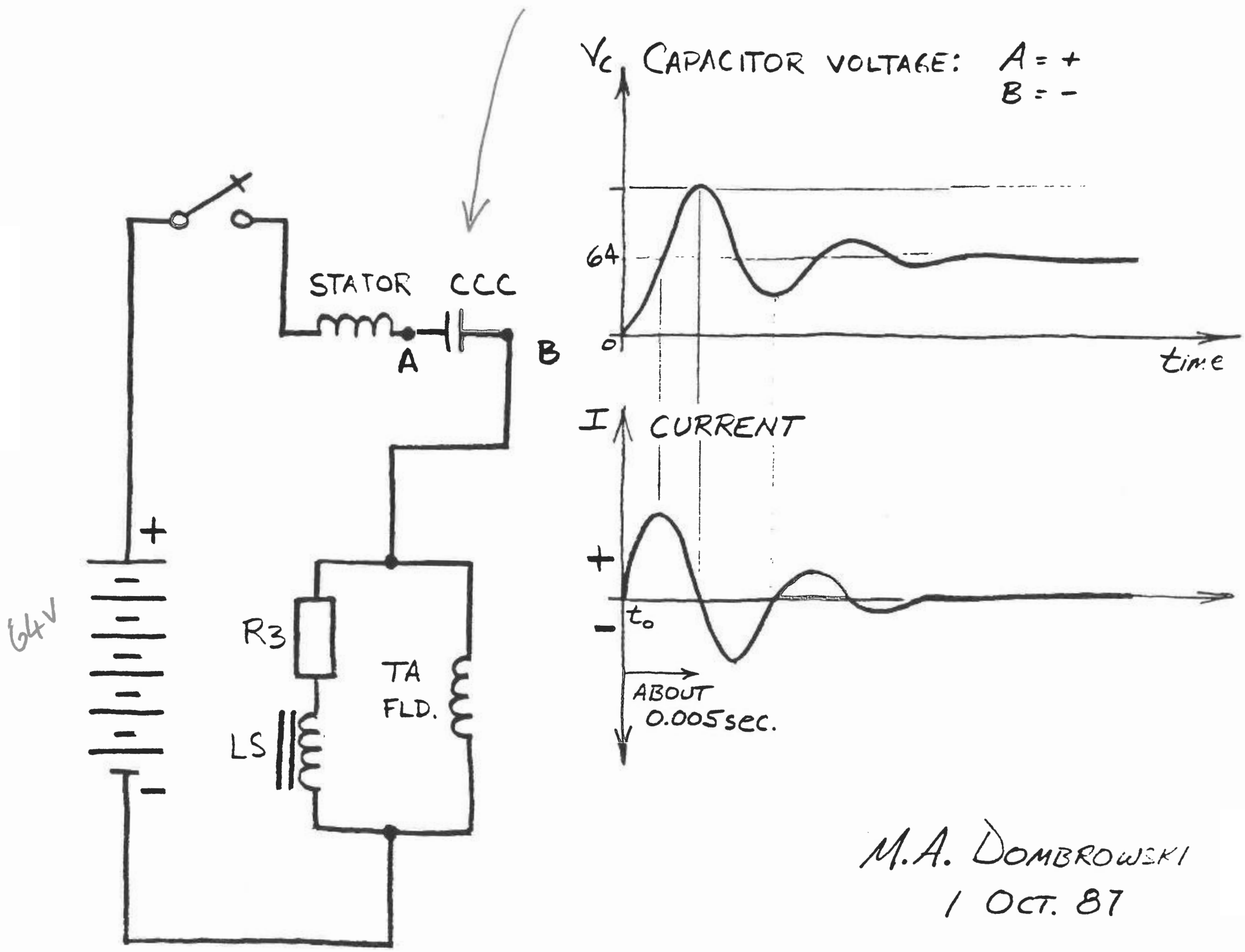
ENGINE START SWITCH TO "START"

CONTACTOR CHECK: PICK-UP ALL 5 CRANKING CONTACTORS

– VERIFY POSITION SENSOR FEEDBACK.

DASH 8 CRANKING - "RING-UP, STEP 1"

(Crank capacitor charged to 100V, and held)



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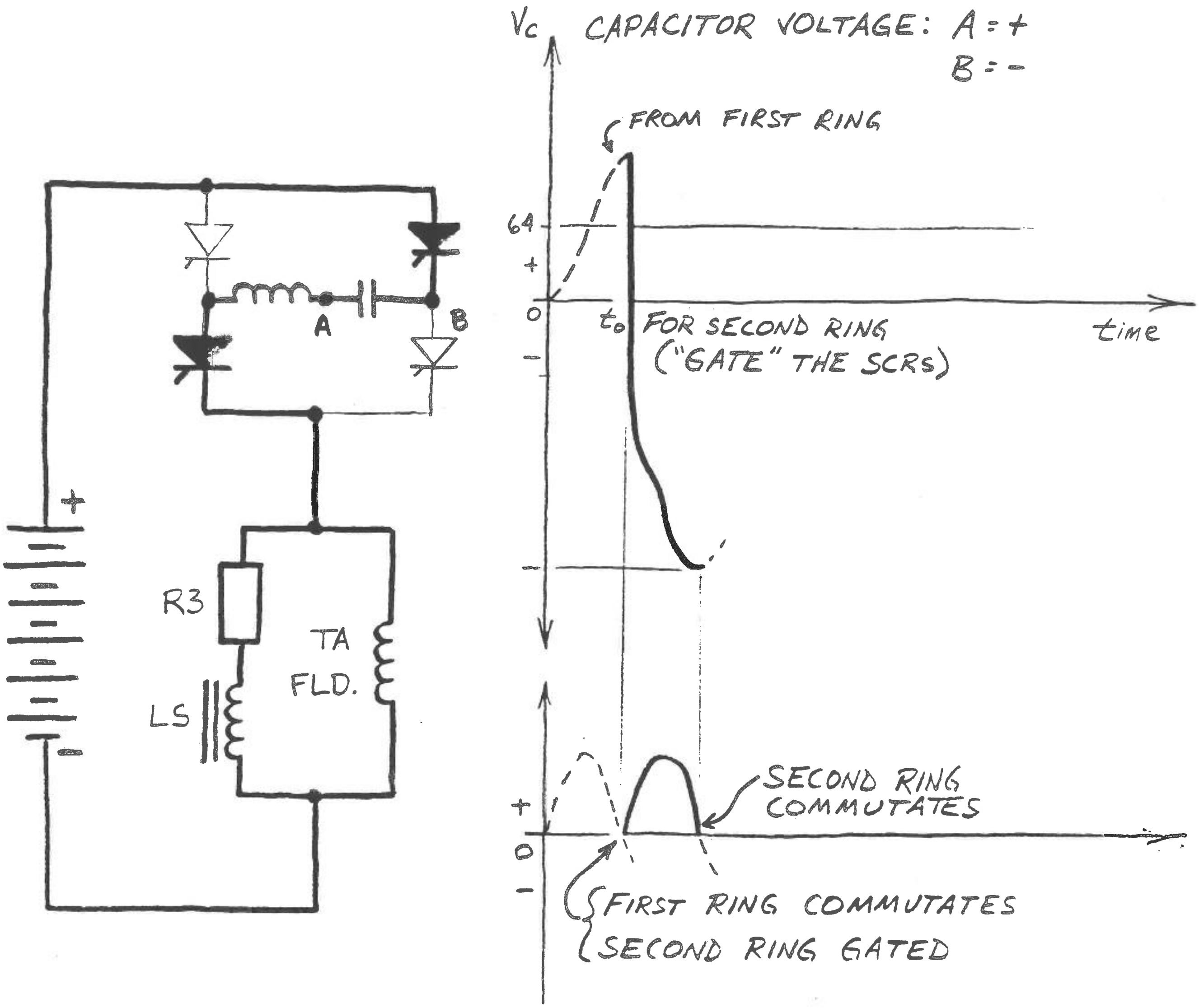
DASH 8 CRANKING - "RING-UP, STEP 2"

(64v battery and 100v in capacitor connected in series)



Reverse polarity in capacitor and double its voltage to 200v

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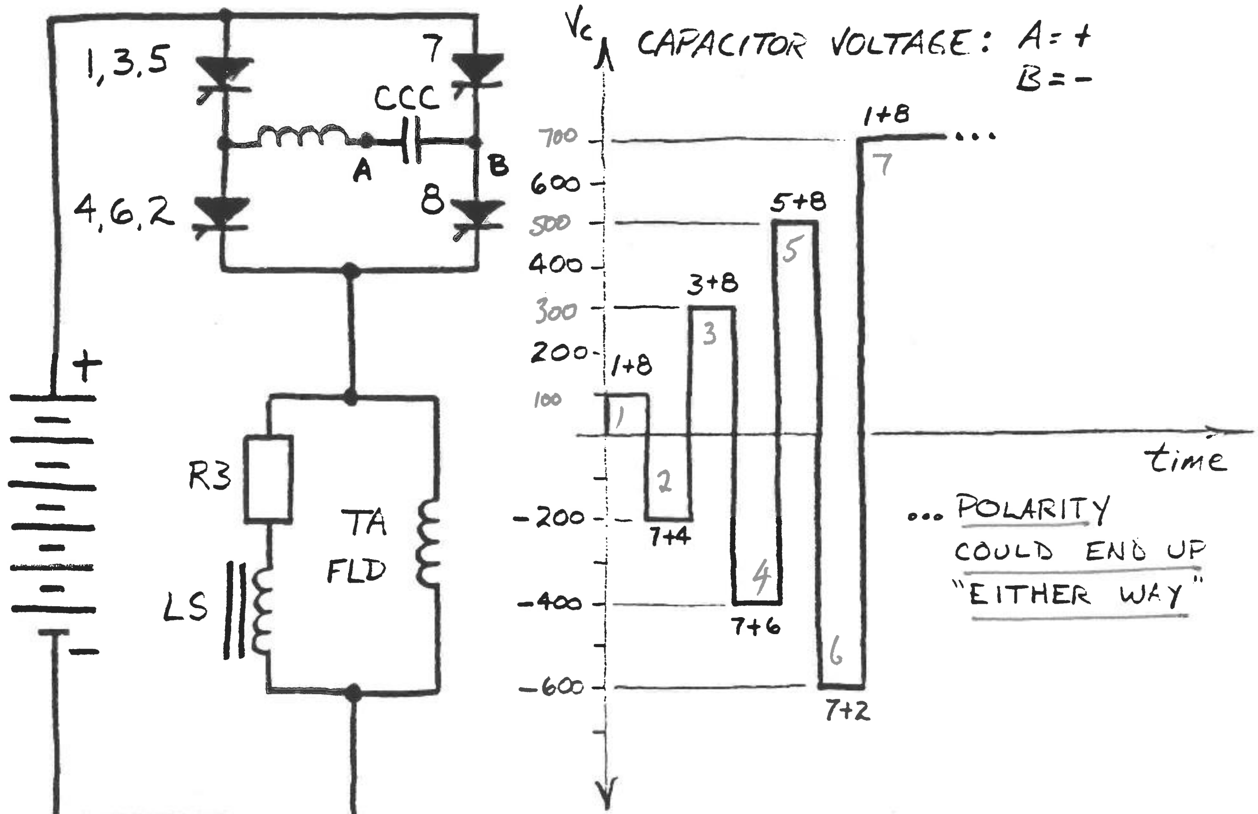
DASH 8 CRANKING - "RING-UP, STEP 3, etc..."

RING-UP RULE: RING TO 600V...
THEN RING "ONE MORE TIME..."



...TYPICAL 5 TO 8 "RINGS"

- IF NOT 600V AFTER 20 TRIES, LOG "CAN'T RING-UP" FAULT.

- IF CCC WON'T RING, LOG APPROPRIATE CTP FAULT.

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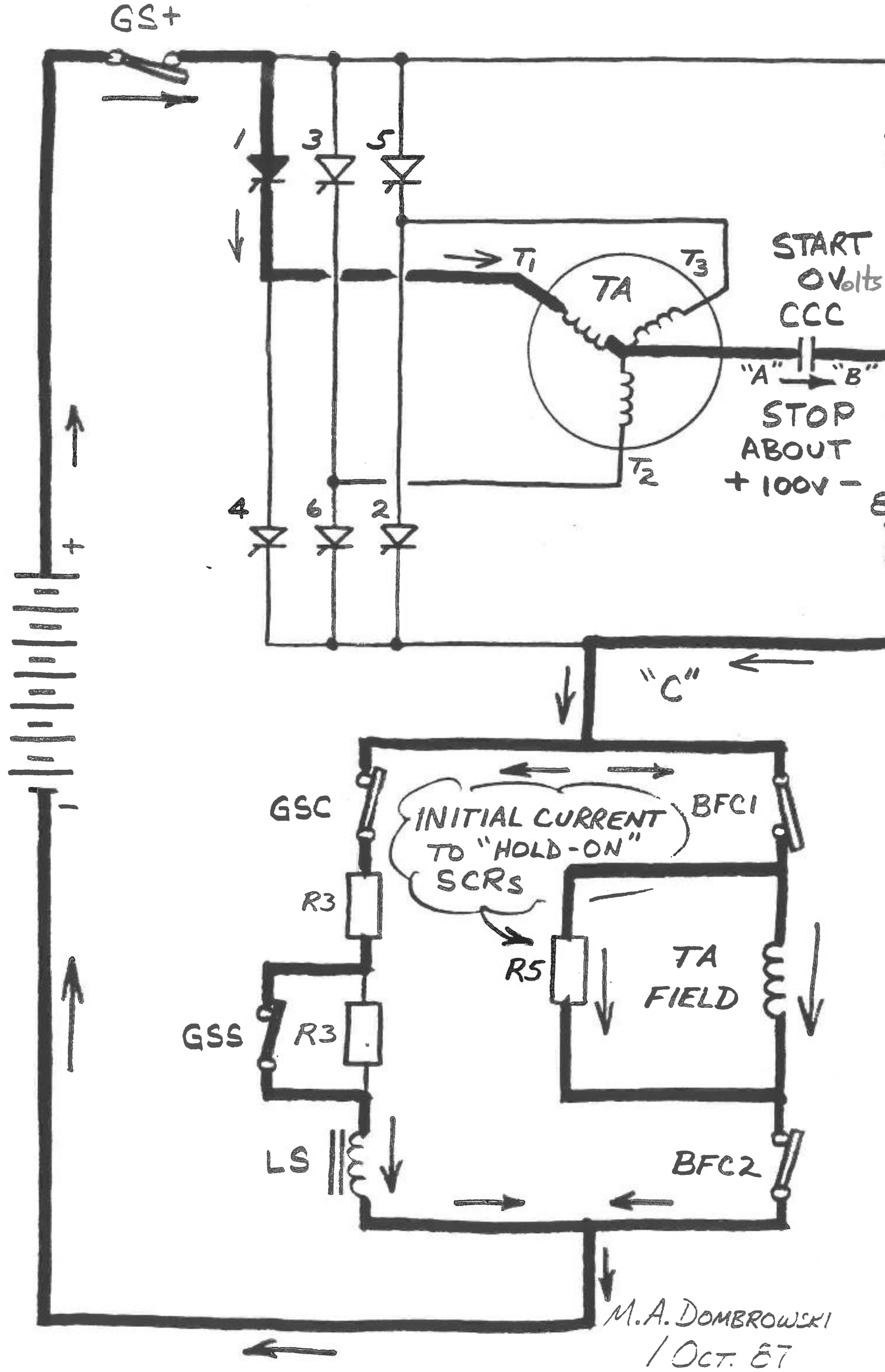
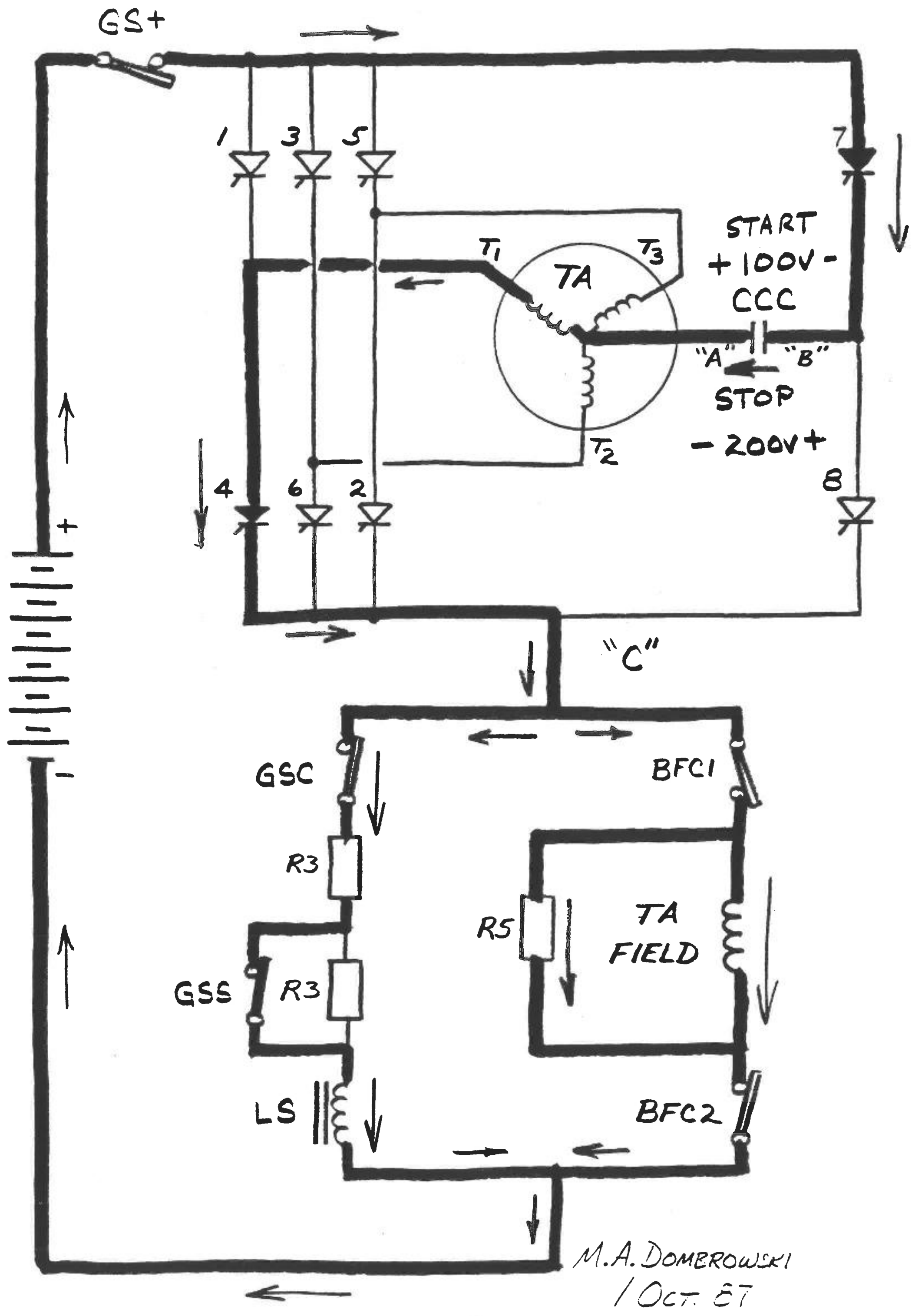
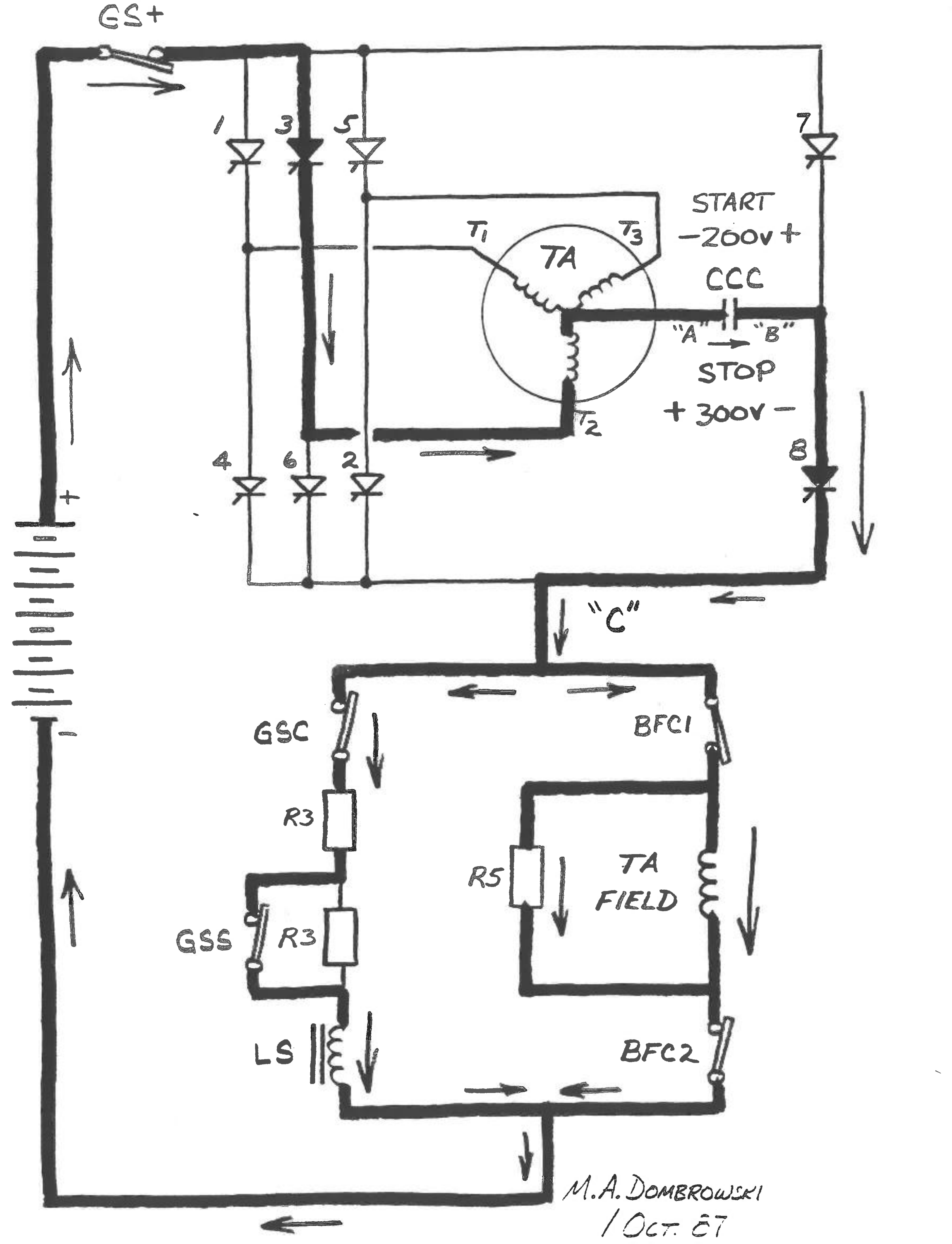


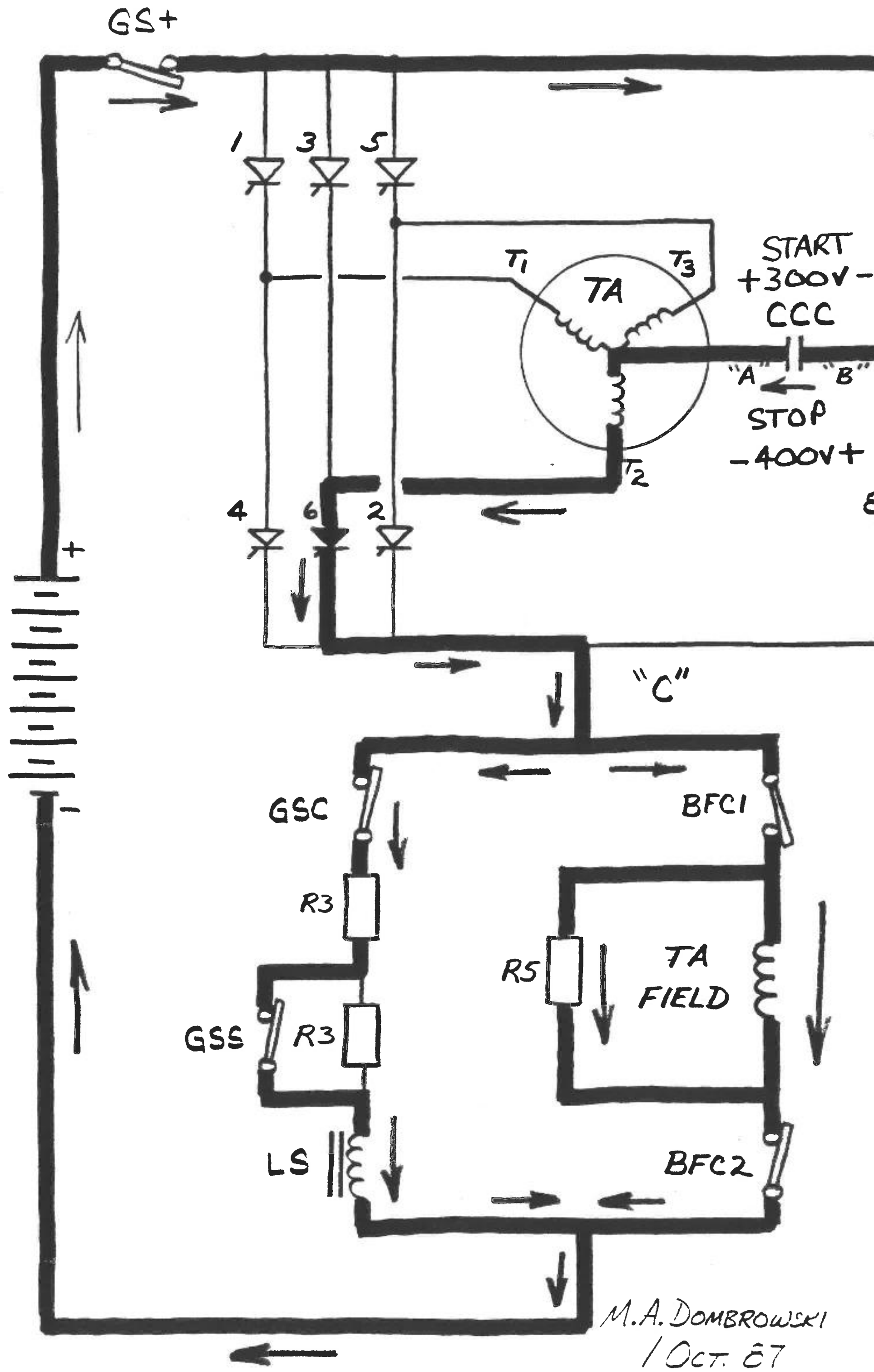
RING-UP: FIRE 1+8 TO START RING-UP



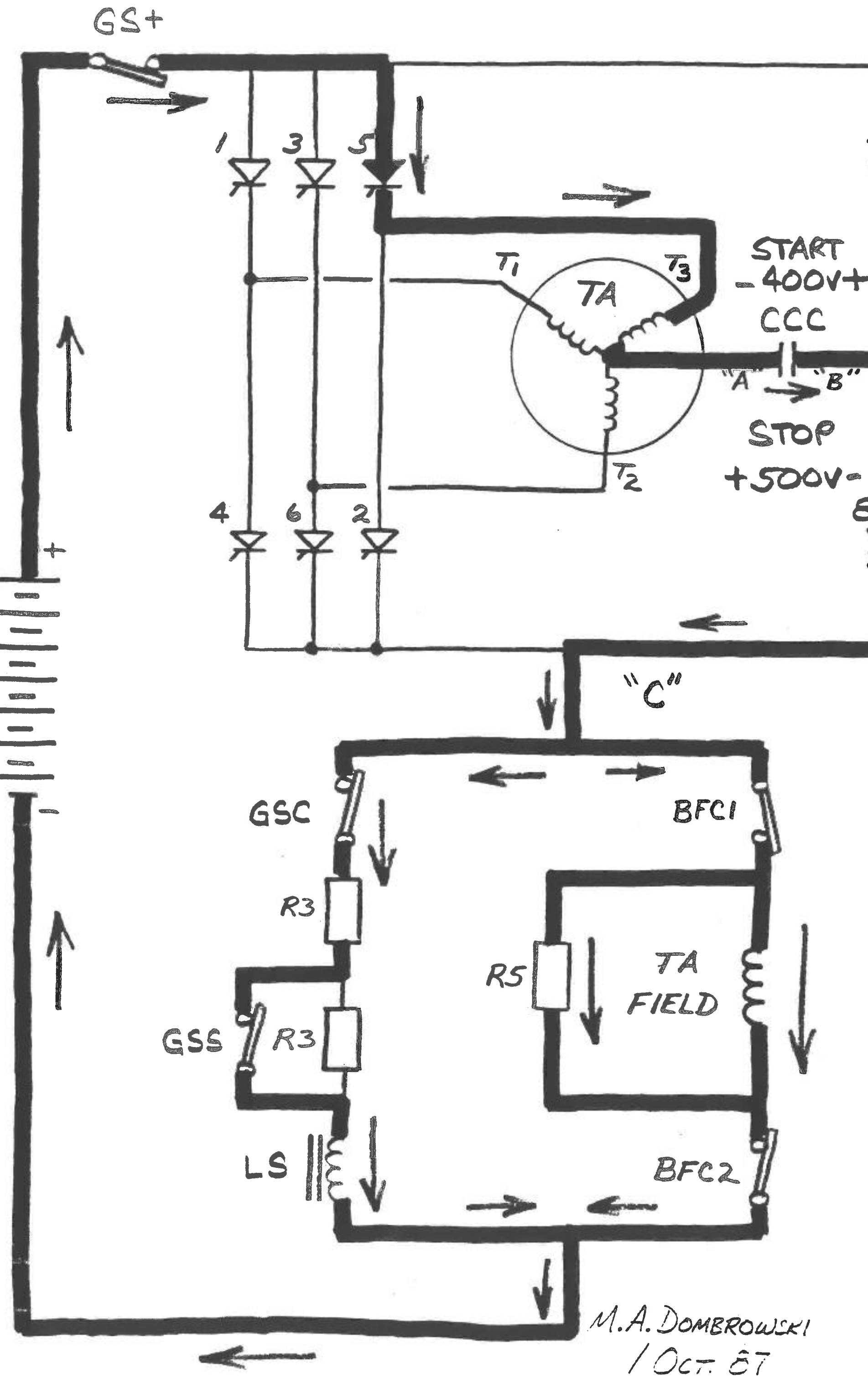
RING-UP : FIRE 7+4 TO RING SOME MORE



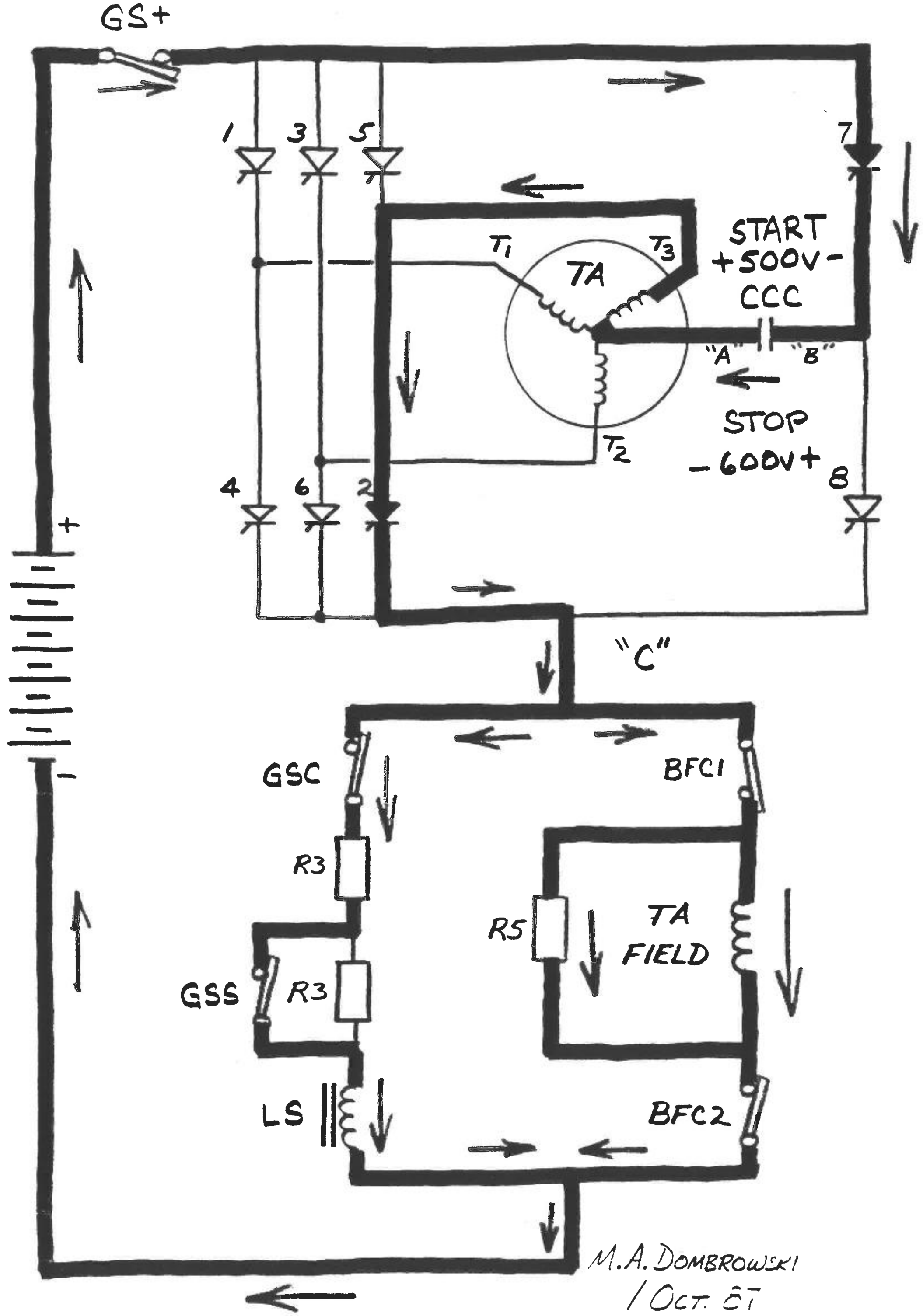
RING-UP: FIRE 3+8 TO RING SOME MORE



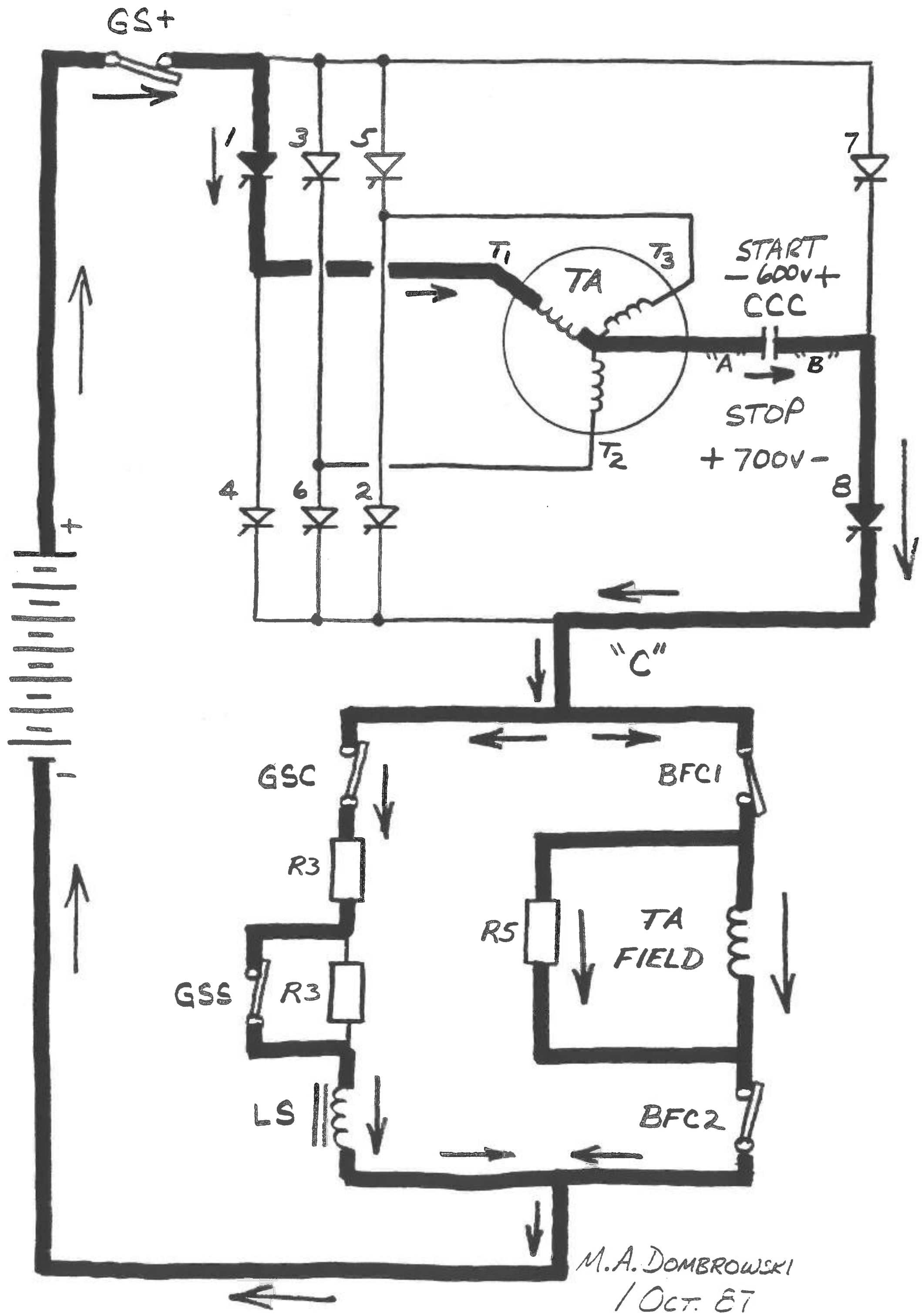
RING-UP: FIRE 7+6 TO RING SOME MORE



RING-UP: FIRE 5+8 TO RING SOME MORE



RING-UP: FIRE 7+2 TO RING SOME MORE



RING-UP: WE'VE GOT 600v ON CCC SO...
FIRE 1+8 TO RING "ONE MORE TIME"

DASH 8 CRANKING - "RING-UP"

WE'RE NOW RUNG-UP.

NOTICE HOW WE USED ALL 3 TA STATOR PHASES TO RING-UP...

(ie ... WE USED CTP1, CTP2 & CTP3.)

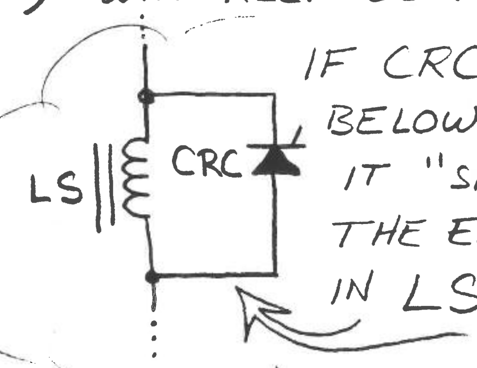
IF WE COULDN'T RING ON ANY PHASE, A FAULT WOULD BE LOGGED AGAINST THE CTP FOR THAT PHASE:

CTP1 - PHASE 1

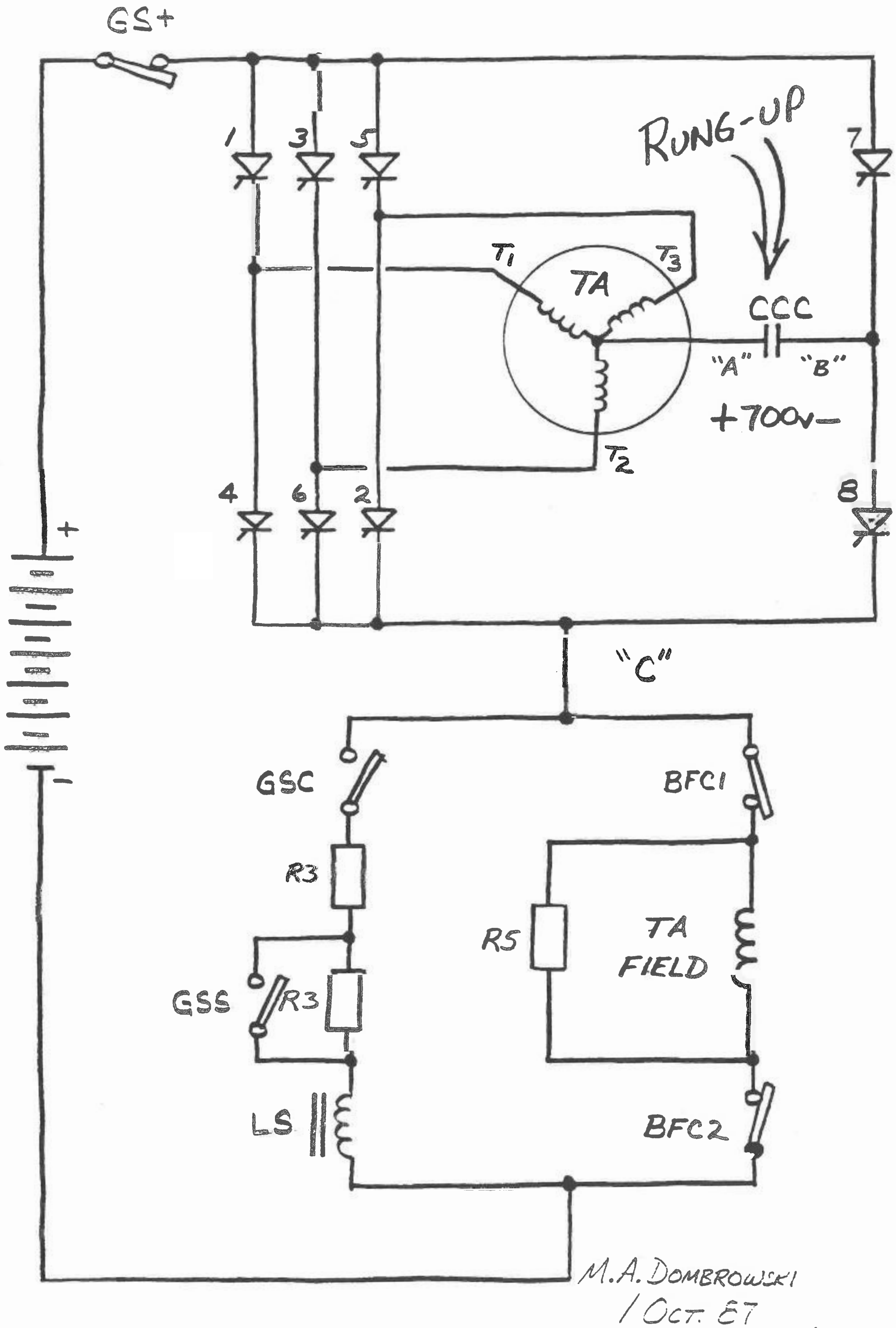
CTP2 - PHASE 2

CTP3 - PHASE 3

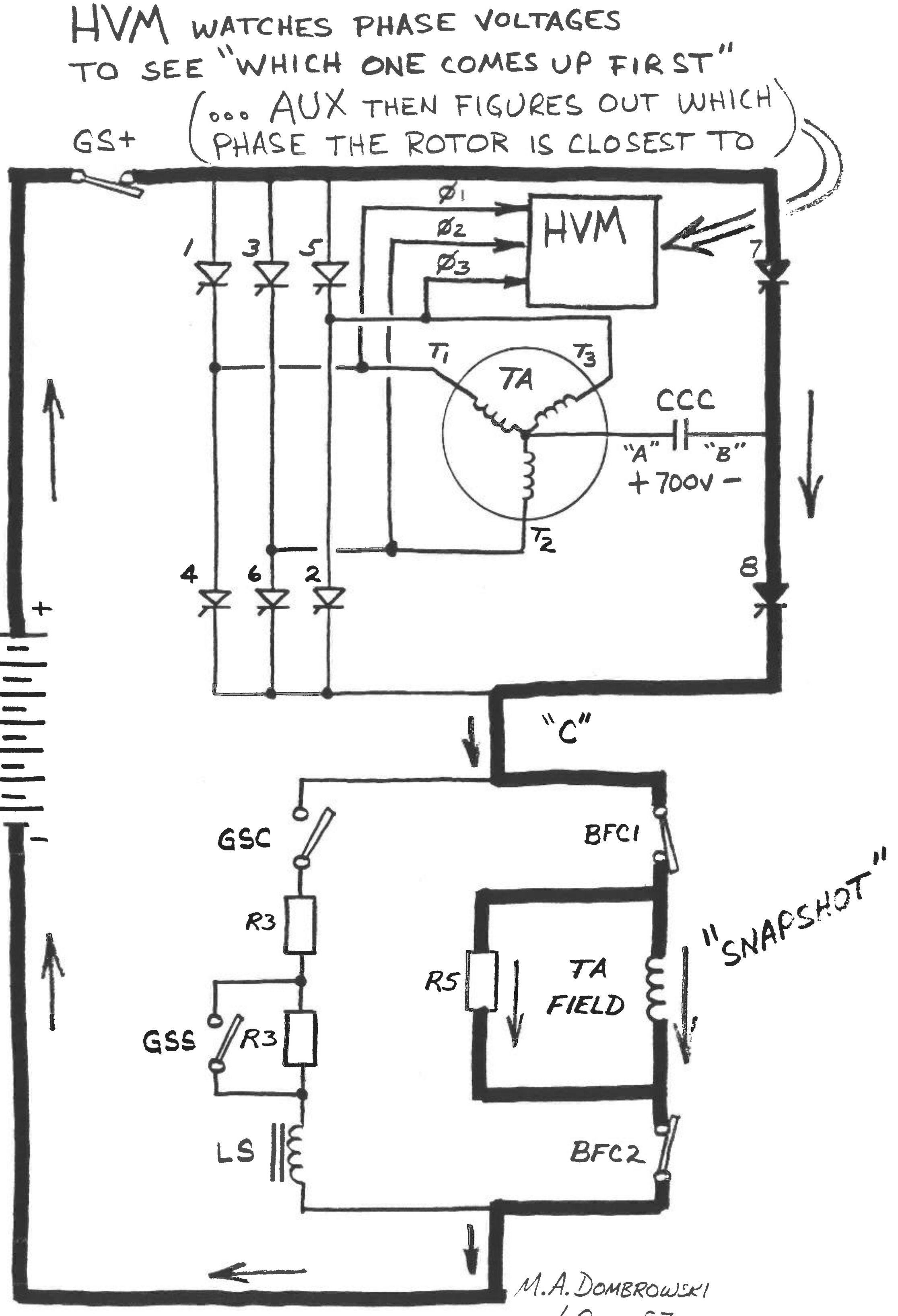
... ALSO - A BAD "CRC" (ONE THAT CUTS-IN BELOW 800V) WILL KEEP US FROM RINGING UP



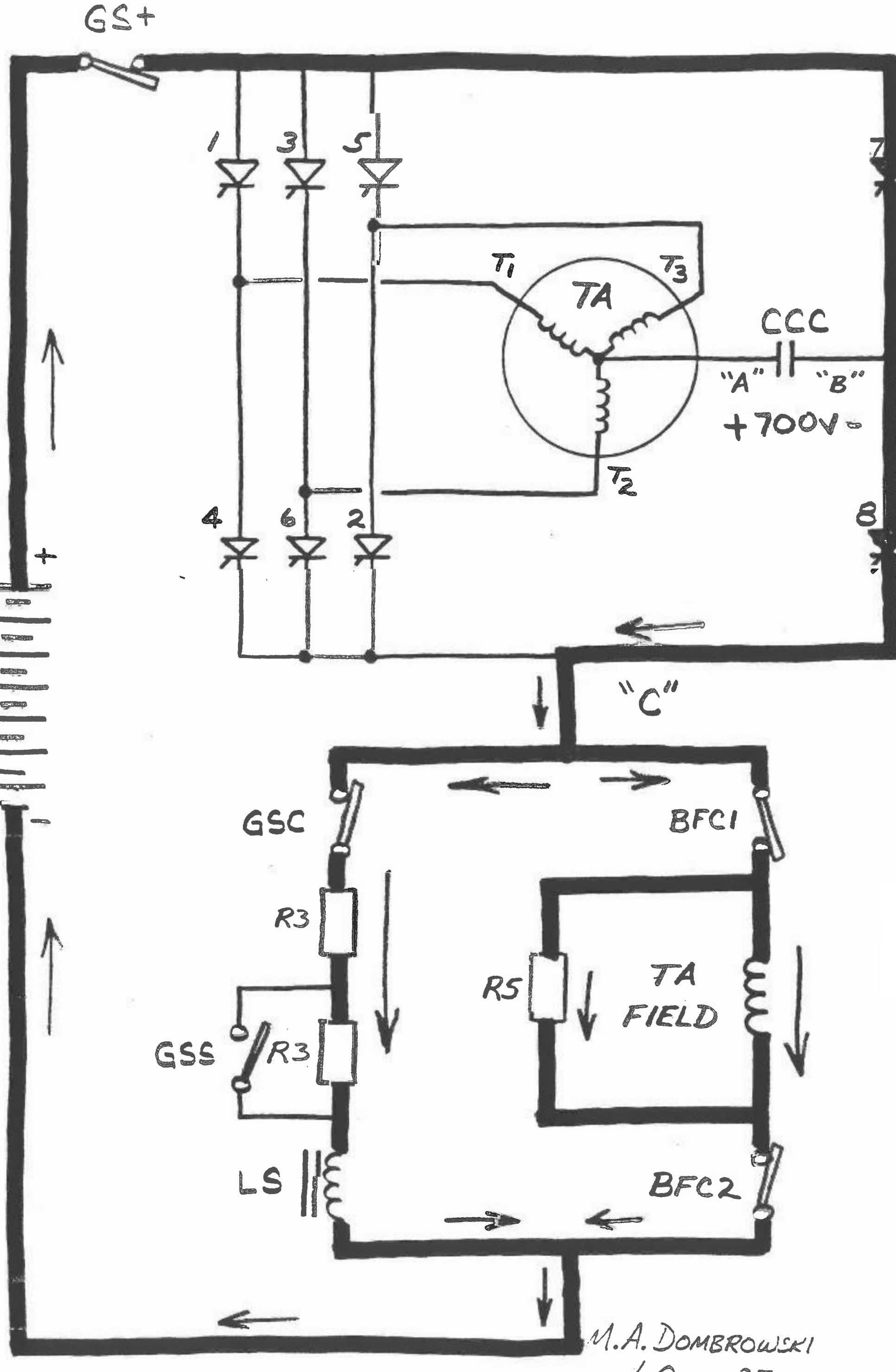
IF CRC CUTS-IN BELOW 800V, IT "SHORTS-OUT" THE ENERGY STORED IN LS



NOW WE'RE RUNG-UP SO DROP-OUT GSC & GSS



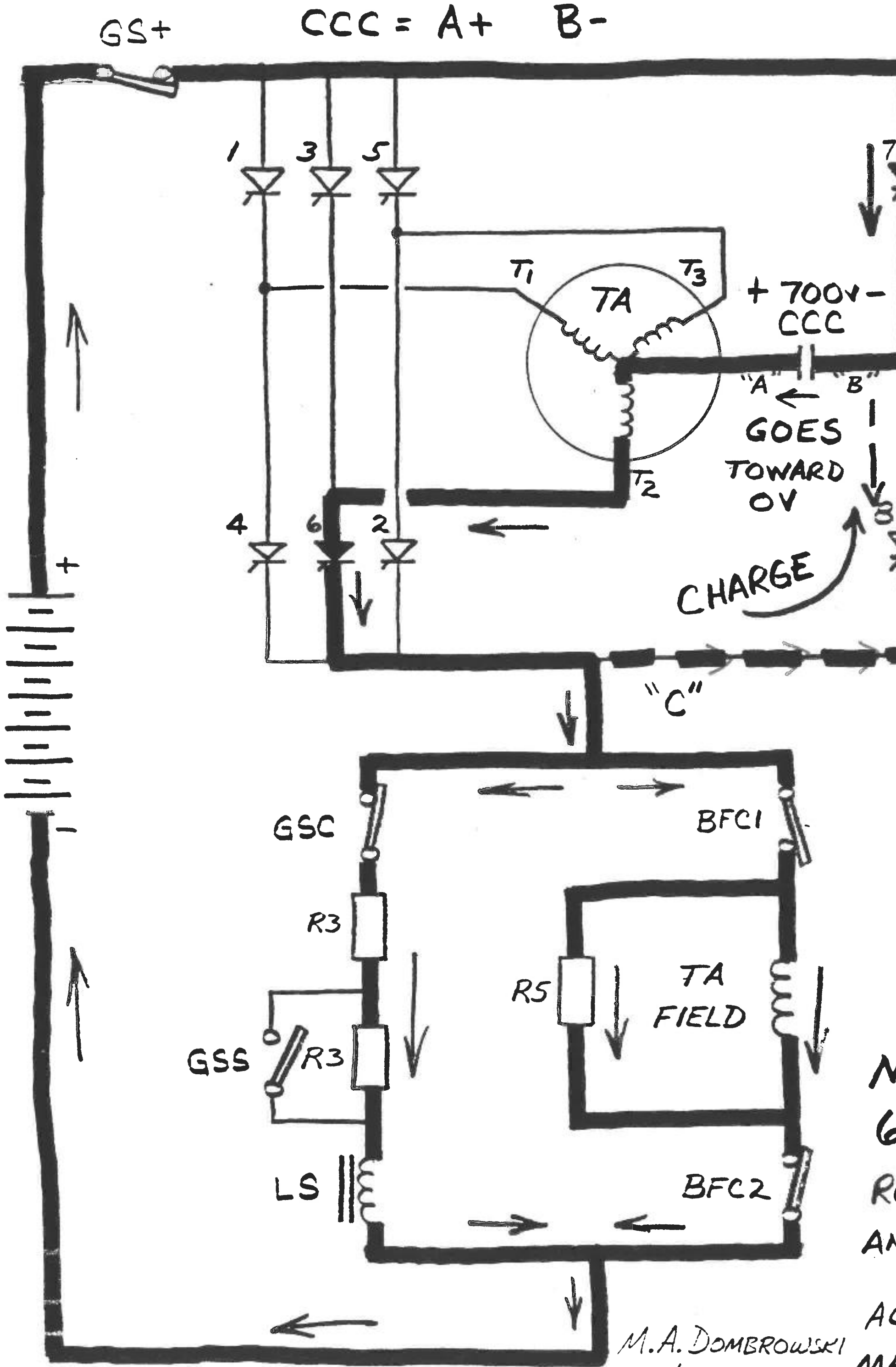
PUT CURRENT THROUGH THE TA FIELD BY FIRING 7 + 8 TO DETERMINE ROTOR POSITION



WE NOW KNOW ROTOR POSITION,
PICK-UP GSC (AMPS STEP-UP) ... TO ABOUT 1000A

START: 7+8 ON - WE MUST SHUT OFF THIS CURRENT

CCC = A+ B-



FIRE 6 TO SHUT OFF 8.

STORED CHARGE DEPLETES SHUTTING OFF 8.

CURRENT DIVERTS FROM 8 TO 6, THROUGH CCC, FROM B TO A.

NOTE: WE CHOSE 6 BASED ON ROTOR POSITION AND CCC POLARITY.

ACTUAL CONDITIONS MAY VARY...

SEE "FIRING ORDER" ON NEXT PAGE...

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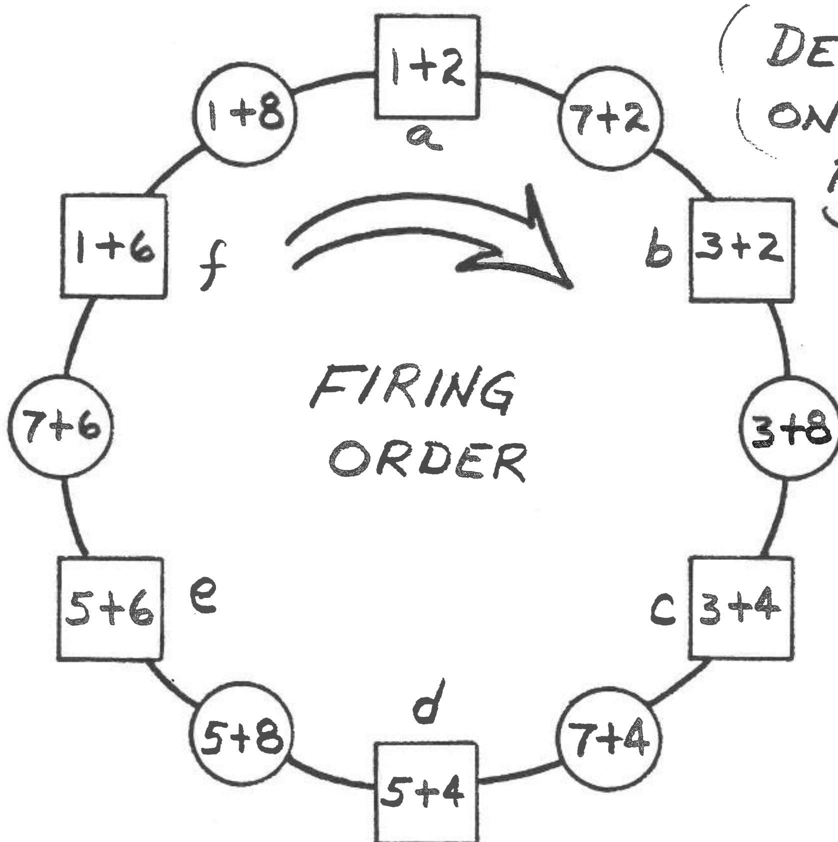
FINISH: (7+6) ON

DASH 8 CRANKING - FIRING ORDER

[1+2] = SCRs 1 + 2 ON

THINK OF THE FIRING ORDER AS A "CLOCK"
WE CAN START ANYWHERE ON THIS DIAL...

(DEPENDING ON ROTOR POSITION.)



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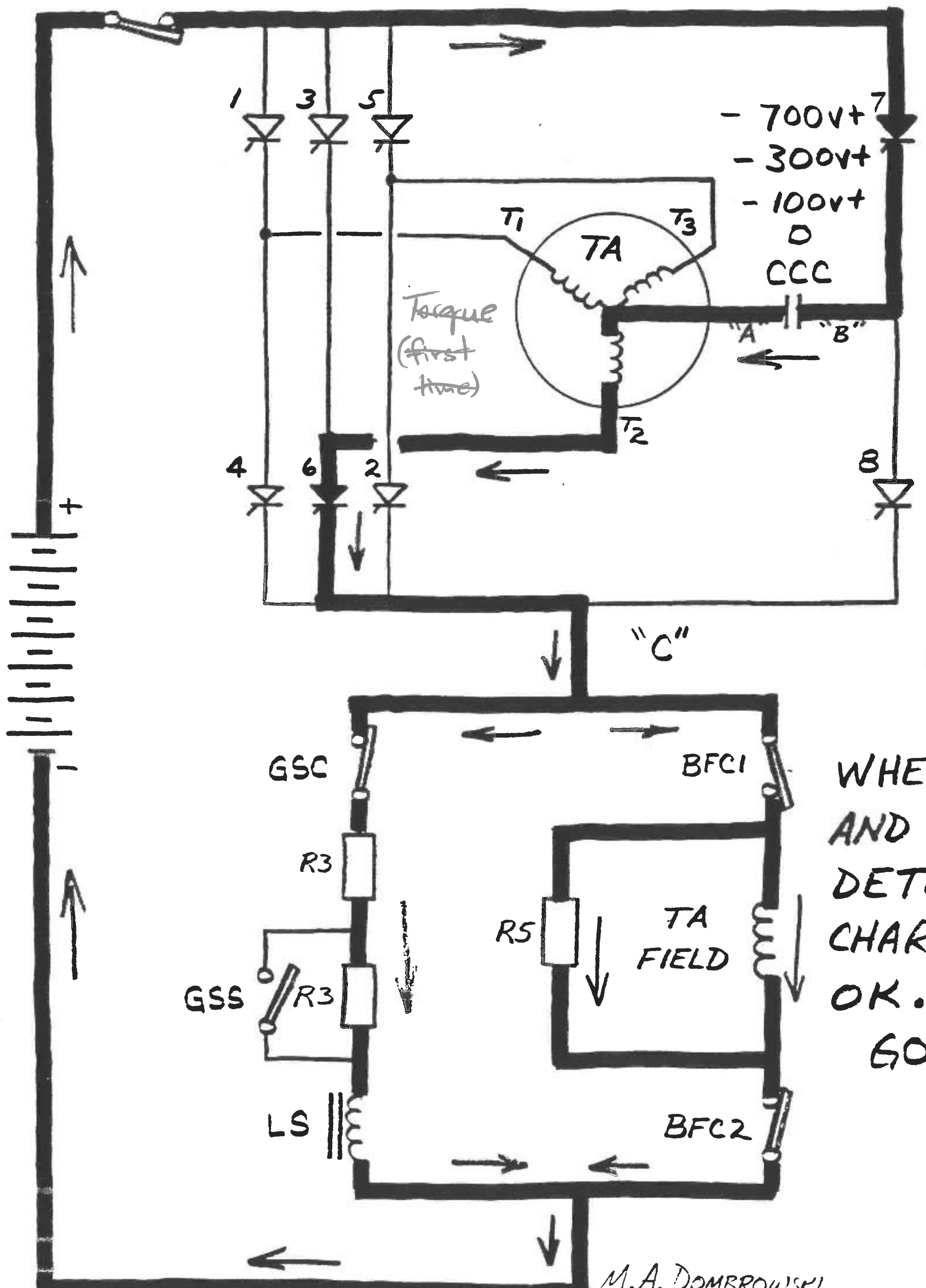
□ = TORQUE STEPS
(STATES a, b, c, d, e, f)

○ = COMMUTATING STEPS

START: (7+6) ON

GS+ CCC CHARGING UP WITH B+ A−



8 HAS SHUT OFF.

INDUCTIVE CIRCUIT WANTS TO KEEP CURRENT FLOWING, SO CCC CHARGES UP WITH B+ AND A−.

WHEN HVM AND AUX DETERMINE CHARGE IS OK... GO ON...

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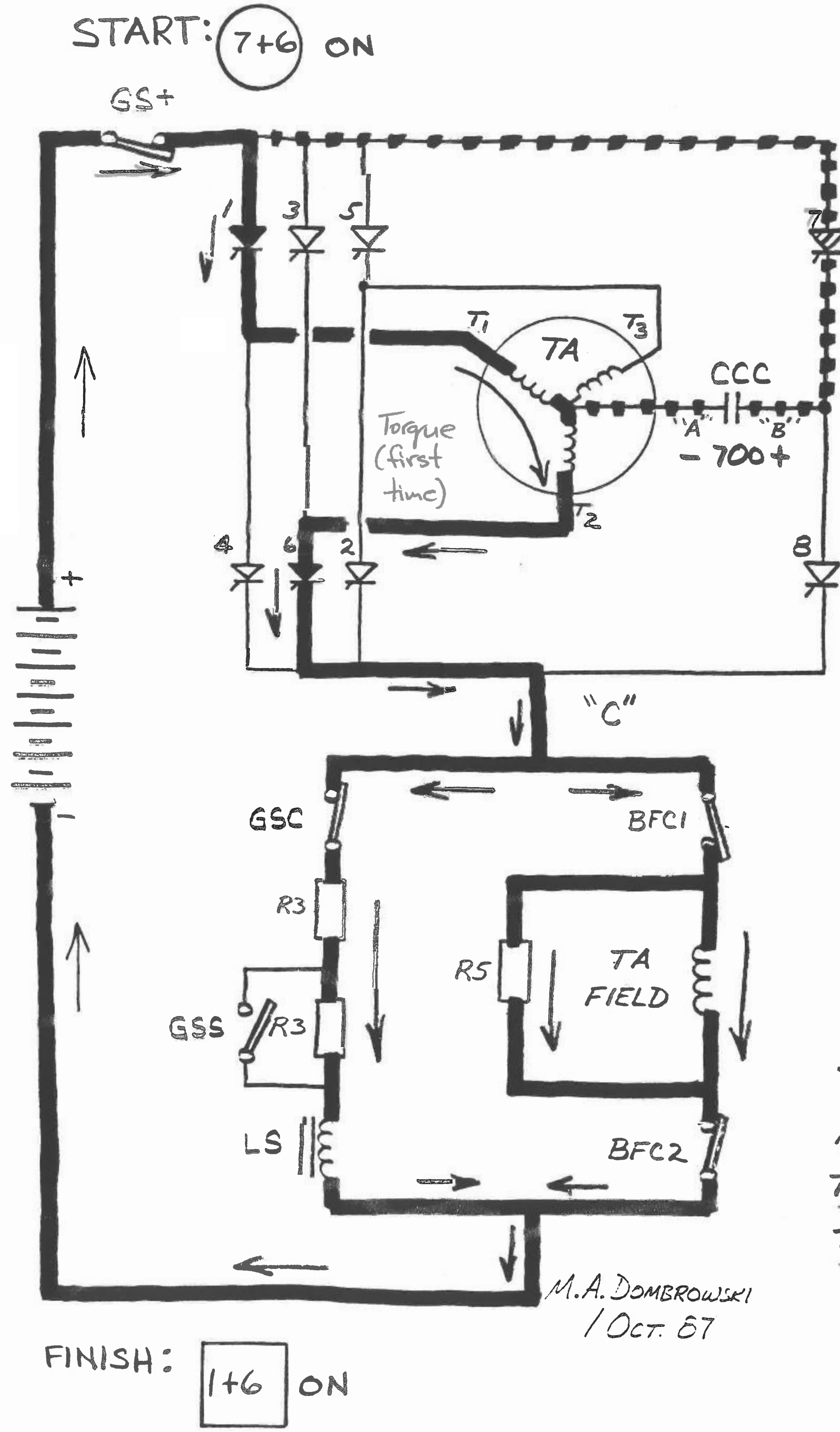
FINISH: (7+6) ON



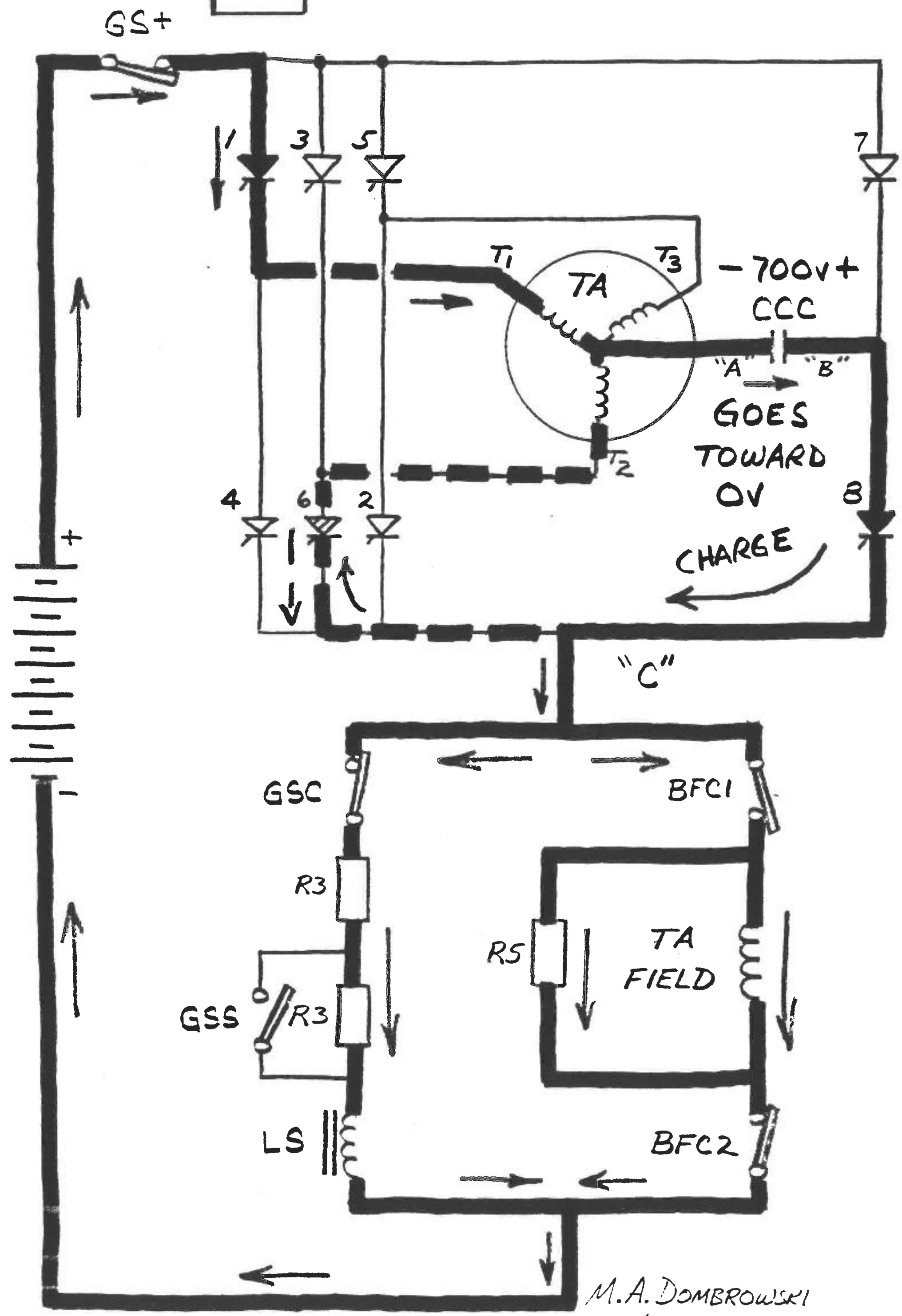
FIRE 1.

7 SHUTS OFF BECAUSE 1 PROVIDES A LOWER IMPEDANCE PATH FOR THE CURRENT, DUE TO THE OPPOSING EFFECT OF THE CHARGE STORED IN CCC.

WE NOW HAVE TORQUE!

THE ROTOR MOVES FOR THE FIRST TIME.

START: 1+6 ON



FIRE 8 TO SHUT OFF 6.

STORED CHARGE DEPLETES SHUTTING OFF 6.

CURRENT DIVERTS FROM 6 TO 8, THROUGH CCC, FROM A TO B.

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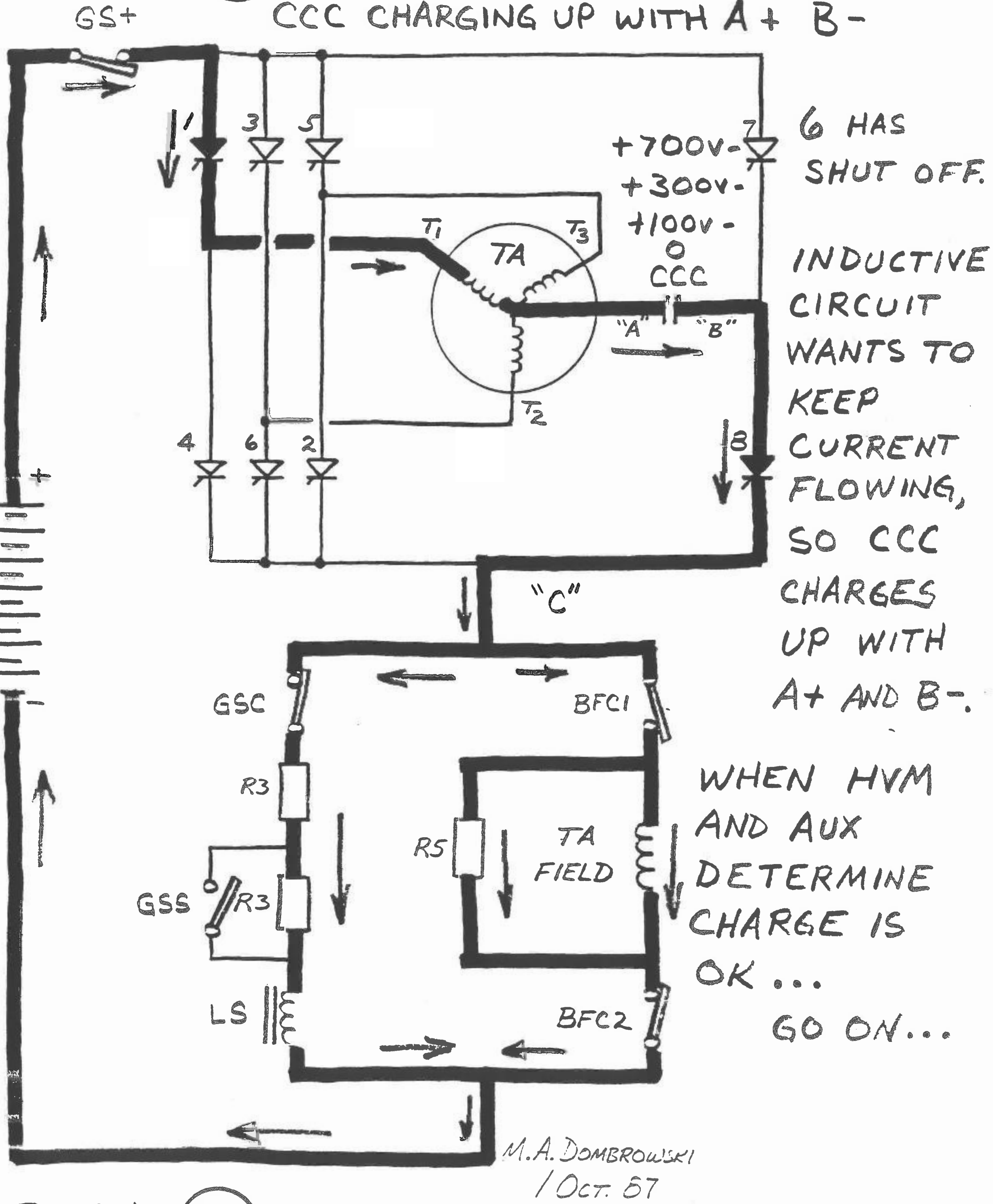
/ OCT. 87

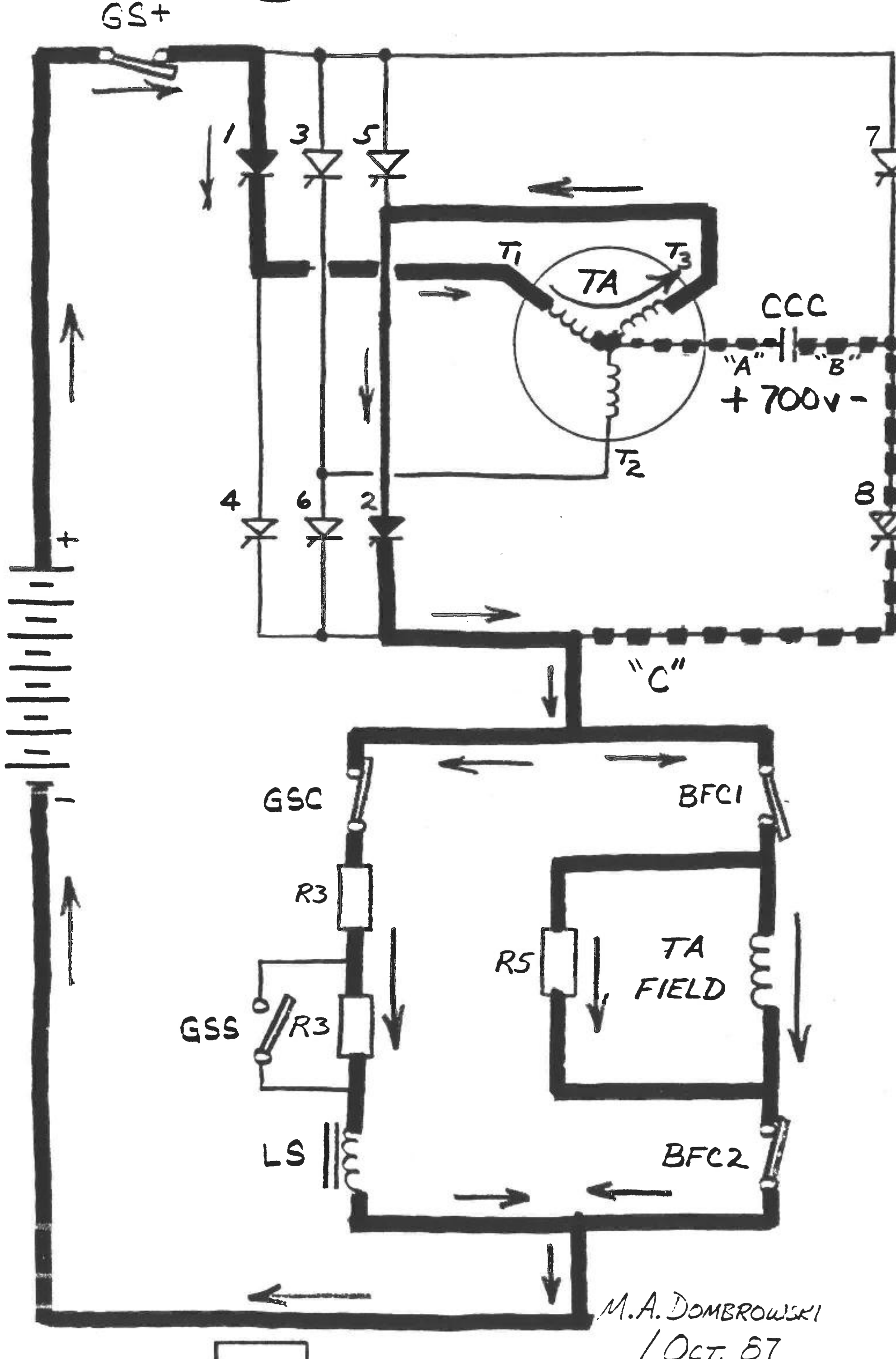
FINISH: 1+8 ON

START: (1+8) ON



FINISH: (1+8) ON

START: (1+8) ON



FINISH: [1+2] ON

FIRE 2.

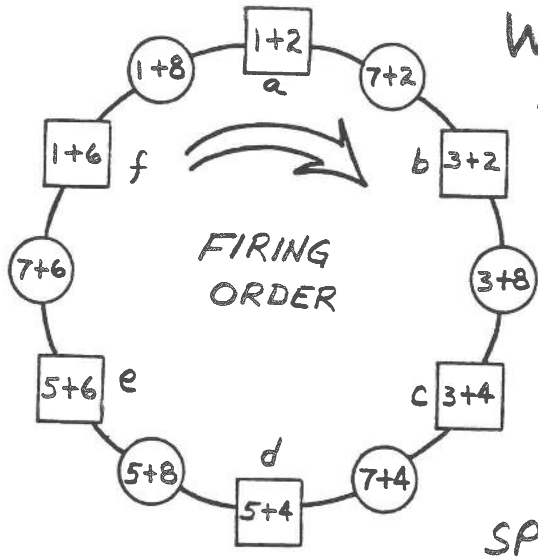
8 SHUTS OFF BECAUSE 2 PROVIDES A LOWER IMPEDANCE PATH FOR THE CURRENT, DUE TO THE OPPOSING EFFECT OF THE CHARGE STORED IN CCC.

WE NOW HAVE MORE TORQUE.

THE ROTOR MOVES SOME MORE.

DASH 8 CRANKING - TORQUE

NOW THAT THE ROTOR IS MOVING, WE ADVANCE THROUGH THE FIRING ORDER.



WE DO THIS IN THE SAME MANNER AS THE PREVIOUS SHEETS HAVE SHOWN.

AS THE ROTOR SPEEDS UP, THE FIRING ORDER IS SPEEDED UP, TO MAINTAIN "PULL" ON THE ROTOR. THE SPEEDING-UP OF THE FIRING ORDER IS DONE BY AUX.

AS THE ROTOR (WITH CURRENT FLOWING IN IT) SPINS IN THE STATOR, AC VOLTAGE IS GENERATED IN THE STATOR PHASE WINDINGS. AS THE ROTOR SPEEDS-UP, THE FREQUENCY OF THIS VOLTAGE GOES UP.

HVM SENSES THESE PHASE VOLTAGES AND RELAYS THEM TO AUX.

AUX COMPUTES THIS INFORMATION AND ADVANCES THE SPEED OF THE FIRING ORDER ACCORDINGLY.

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1 OCT 87

DASH 8 CRANKING - TORQUE

NOTE FROM THE CIRCUIT DRAWINGS THAT

"UPPERS COMMUTATE UPPERS"

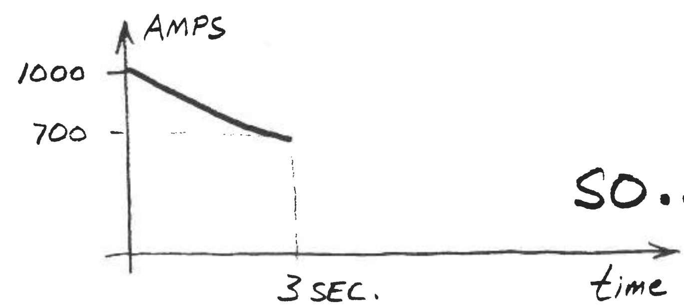
AND

"LOWERS COMMUTATE LOWERS"

... THAT IS, THE UPPER, OR ODD-NUMBER SCRs (NUMBER 1, 3, 5 AND 7) ARE USED TO "COMMUTATE" OR "SWITCH OFF" ANOTHER ODD NUMBER SCR.

... LIKEWISE FOR THE LOWER, OR EVEN-NUMBER SCRs (NUMBER 2, 4, 6 AND 8).

AS THE ROTOR SPEEDS-UP, THE CURRENT DECREASES AND TORQUE DROPS OFF:



SO...

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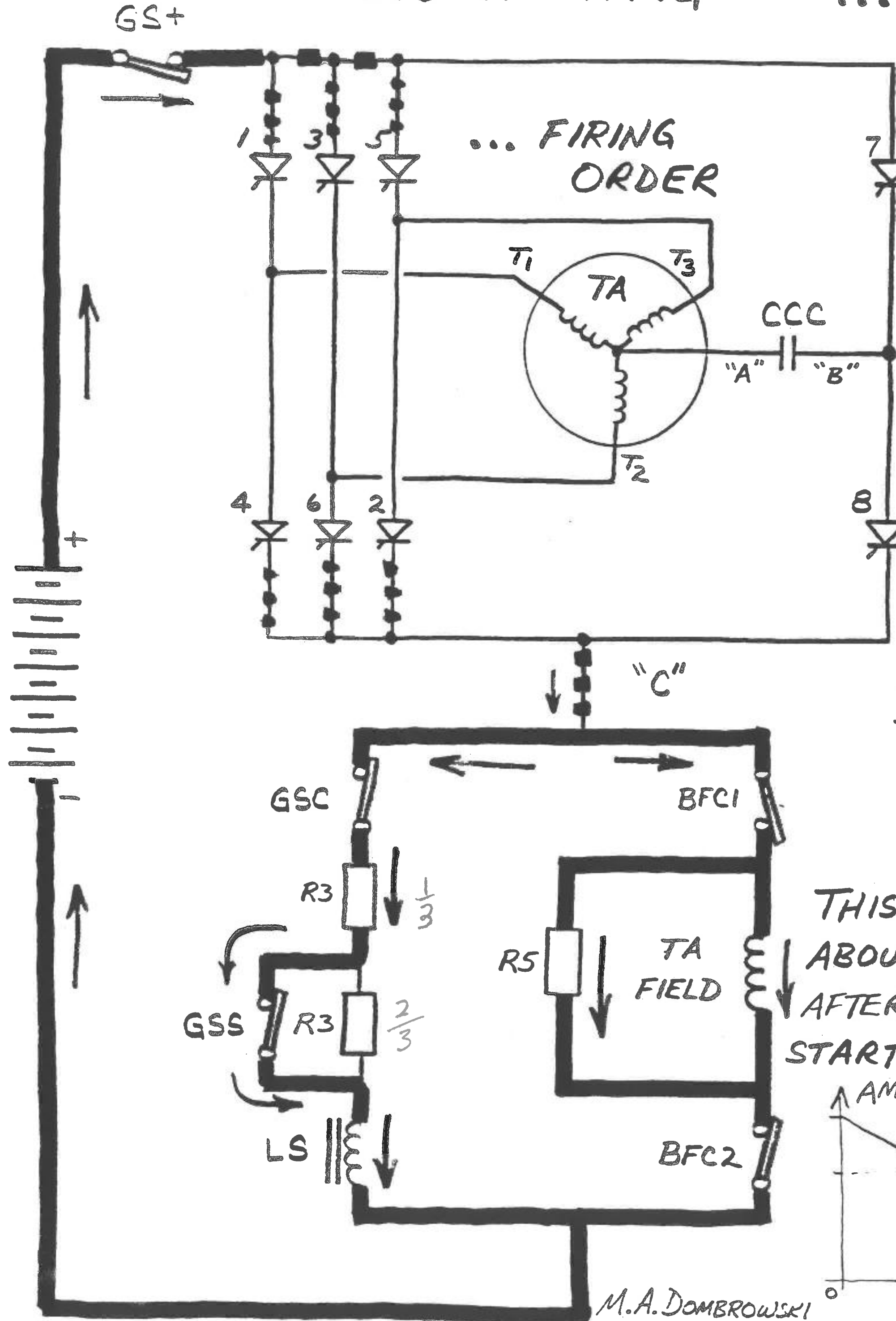
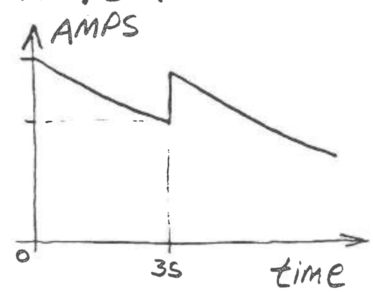
FIELD SHUNTING

... WE CONTINUE THE FIRING ORDER, AND PICK-UP GSS TO "SHUNT" THE TA FIELD.

GSS SHORTS-OUT A SECTION OF R3, AND CRANKING AMPS STEP BACK UP TO MAINTAIN TORQUE ON THE ROTOR.



THIS HAPPENS ABOUT 3 SECONDS AFTER THE ROTOR STARTS TO MOVE.



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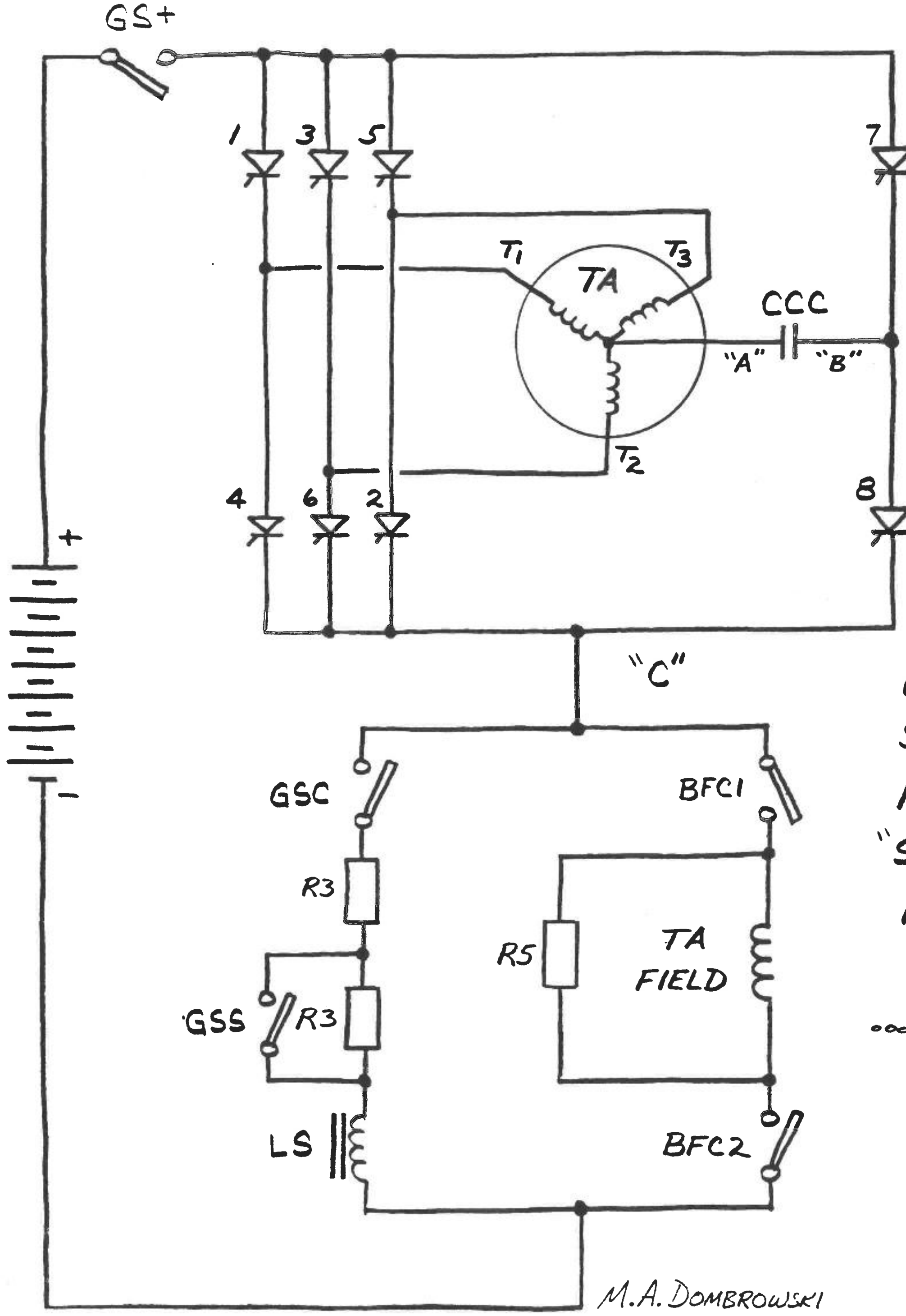
NOTE THAT THIS IS THE ONLY TIME THAT A DASH 8 MAKES "TRANSITION"! (joke)

... STARTING



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THE ENGINE FIRES ... AND STARTS.

WHEN ENGINE SPEED IS AROUND 200 RPM, ALL CRANKING CONTACTORS DROP-OUT... EVEN IF THE ENGINE START SWITCH IS HELD IN THE "START" POSITION.

... AND WE'RE DONE!

(whew!)

GENERAL COMPARISON TABLES

DASH 7 TO DASH 8 (1987 MODEL) LOCOMOTIVES

PURPOSE: To compare features of General Electric Dash 7 and Dash 8 road locomotives.

Familiarity with GE's Dash 7 models will help in interpreting this table.

FEATURE	ON DASH 7'S THIS IS	ON DASH 8'S THIS IS...
Diesel Engine	Both Dash 7 and Dash 8 locomotives use the GE 7FDL turbocharged diesel engine. The Dash 8 uses the 7FDL12 (12 cylinder) and 7FDL16 (16 cylinder) engines.	
Traction Motors	GE-752E and GE-752AF series motors	GE-752AG series motors Traction motors are connected in parallel for best adhesion.
Traction Alternator and Transition	GTA-11 or GTA-24 style Traction Alternator. Traction Motor or Traction Alternator transition, depending on locomotive configuration.	GMG-186 (B locomotive) or GMG-187 (C locomotive) style machines. No transition system required, as Traction Alternator/Rectifier package can supply both high current and high voltage requirements without switching.

COMPARISON TABLES

FEATURE	ON DASH 7'S THIS IS	ON DASH 8'S THIS IS...
Auxiliary Power	GY-27 style Exciter and Auxiliary Generator are mounted on the alternator and driven by the alternator shaft through gearing and a gear box. The Exciter provides excitation power for the Traction Alternator. The Auxiliary Generator provides power for the control system and battery charging.	An Auxiliary Alternator is used, mounted on the same shaft and in the same frame as the Traction Alternator. The Auxiliary Alternator has three 3-phase output windings that provide power for: 1) propulsion and auxiliary excitation 8 o'clock 2) battery charging 9 o'clock 3) running the AC fans and blowers. 7 o'clock The rotating fields for both the Traction and Auxiliary Alternator are on a common shaft.
Engine Cranking	Both GY-27 machines are used as motors to crank and start the diesel engine.	To crank and start the diesel engine, the traction alternator is used as a synchronous motor, with AC power developed by a locomotive battery powered cranking inverter.
Battery Charging	A GY-27 d-c machine with solid-state voltage regulator.	One three phase AC output winding of the Auxiliary Alternator with static Battery Regulator.
Air Compressor Drive	Shaft driven from the diesel engine.	AC motor driven. No coupling to engine; runs only to pump air.
Propulsion Excitation System	CHEC excitation control system with GY-27 d-c exciter.	MICROCHEC: Microcomputer excitation control, similar to CHEC, with solid-state Traction Alternator field regulator.

FEATURE	ON DASH 7'S THIS IS	ON DASH 8'S THIS IS...
Equipment Blowers	One blower, mechanically driven by a shaft from the diesel engine. This blower is rotating constantly, proportional to diesel engine speed. This blower provides cooling air for the traction motors, traction alternator, rectifier panels, exciter, auxiliary generator, control compartments and air for the operator's cab heater.	Three blowers, each separately driven by three-phase AC induction motors.
		ABM: * Alternator Blower located in the blower compartment above the alternator area. * This blower operates at a constant ratio of diesel engine speed. * This blower provides cooling air for both traction and auxiliary alternators, the power rectifier panels, and the solid-state excitation regulators.
		EB1: * Equipment Blower 1, located in the blower compartment above the alternator area. * This blower provides cooling air for the short hood truck traction motors and the solid-state AC motor speed controllers.
		EB2: * Equipment Blower 2, located in the long hood end of the locomotive. * This blower provides cooling air for the long hood truck traction motors.

FEATURE	ON DASH 7'S THIS IS	ON DASH 8'S THIS IS...
Radiator Fans	One radiator fan, mechanically driven by shaft and gearbox from the diesel engine. On some models, fan speed is controlled by an eddy-current clutch on the mechanical drive.	One radiator fan, driven by a three-phase AC induction motor. Fan speed is set by the computer from cooling water temperature, as measured by a solid-state thermistor probe.
	NOTE: AC motor speed for the radiator fan and both traction motor blowers on the Dash 8 are controlled by solid-state regulators.	
Radiator Water Flow Control	A Fluid Amplifier system with thermostatic "pill" to control switching of engine cooling water to radiators.	A "Butterfly Valve" actuated by main air reservoir pressure switches engine cooling water to radiators. The Butterfly Valve is computer controlled, using a solid-state thermistor probe to sense engine cooling water temperature.
	NOTE: Both Dash 7 and Dash 8 locomotives use a "dry radiator system", with cooling water in the radiators only when engine cooling is required.	
Wheel Slip Control System	Current Measuring Reactor or SENTRY adhesion control system, depending upon locomotive configuration.	MICROSENTRY: Microcomputer adhesion control, similar to SENTRY, interfacing with microcomputer excitation system for quicker wheelslip correction. (EXC)

FEATURE	ON DASH 7'S THIS IS	ON DASH 8'S THIS IS...
Control Electronics	Control electronics are contained on "blue-face, 17FD-series" printed circuit cards. These plug in FD cards are usually the smallest order of control components changed in running repair.	Control electronics are housed in packages called Replaceable Units, or RUs. These RUs, designed for quick change-out, are the smallest order of control component to be replaced on the Dash 8 locomotive. The microcomputer control system for the Dash 8 locomotive is housed in these RUs. Maintainers will not be changing out printed circuit boards in the microcomputer system, only the entire RU.
Interlocks	Interlocks are mounted on contactors which provide logic information to other circuits on the locomotive. Any contactor usually has more than one circuit which is switched by these interlocks. The "logic circuits" in this case are "hardwired", that is, they consist of mechanical interlock switches and wiring connecting these switches to control locomotive functions.	One "Position Sensor" is mounted on each contactor. The Position Sensor is just a single-pole double-throw switch which provides a signal of the contactor's position (picked-up or dropped-out) to the microcomputer control system. The microcomputer contains the logic circuits which control locomotive functions (Motoring, Dynamic Braking, Self-Load, etc.) The logic which controls locomotive functions is called firmware and is embedded in the microcomputer.

CAB
EXC
AUX

AFR
BFR
BRP

EBP
RFP

FEATURE	ON DASH 7'S THIS IS	ON DASH 8'S THIS IS...
Indicators	Indicating lights are provided on the Engine Control panel which indicate a single fault (such as "No Battery Charge").	The Diagnostic Display panel (DID panel) serves the function of the older-style indicating lights... plus much more.
	Indicating lights are also provided on the Annunciator Panel which light to indicate a single fault.	The DID panel, linked directly to the microcomputer control system, provides communication between maintainers and the locomotive.
	Mechanical latching relays (with an indicating light) are used to provide maintainers with fault indications, and require manual reset.	DID can show: 1) SUMMARY messages, (65 total) or an indication of locomotive operating status, or any restrictions to performance. 2) A FAULT LOG of (1000 total) control system faults, which are stored into memory and are not erased when the battery switch is opened. 3) A list of MONITOR (40 total) parameters, which use DID as a "super meter" to monitor locomotive systems in real-time. 4) A SELF-TEST program (100 steps) which is used to qualify the locomotive control system.