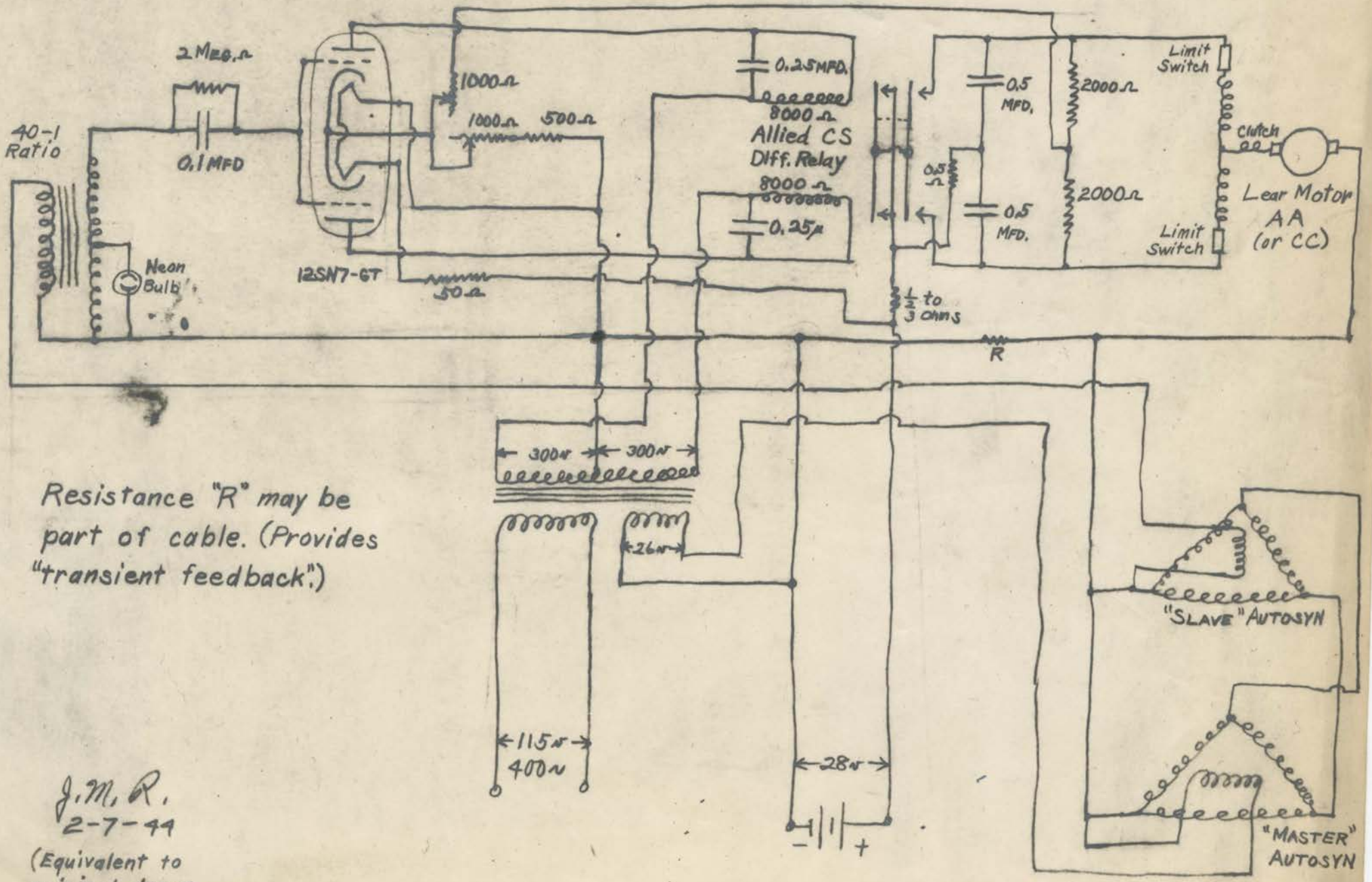
SCHEMATIC CIRCUIT OF "LEARTRON" CONTROL



Resistance "R" may be part of cable. (Provides "transient feedback".)

J. M. R.
2-7-44
(Equivalent to original drawn 11-30-43).

End of this document

For Mr. A.E. Page

52-5

Inter-Office Correspondence

LEAR AVIA INC.

AVIATION INSTRUMENTS & ACCESSORIES

Memo To ..... Date January 12, 1944

From J. M. Roberts Branch .....

Subject .....

SOME METHODS OF STABILIZING ELECTRONIC RELAY MOTOR CONTROLS

(Referring to photostats of sketches by J. M. Roberts, dated August 10, 1943, September 11, 1943, October 1, 1943, October 21, 1943, November 10, 1943, November 17, 1943, November 30, 1943, and a sketch by Oswald Ariagno, dated December 13, 1943.)

The following is a brief explanation of some of the methods of stabilizing these circuits:

(A) "Anticipation Effect Due to R and C in Grid Circuit: Referring to one of the grid circuits of the sketch of September 11, 1943, the parallel combination of a 0.5 megohm resistor and a 0.05 microfarad condenser in series with a grid of the twin-triode tube has very little effect for weak voltage "signals" from the Selsyns (Autosyns), corresponding to small angular displacement of the "master" and "slave" Autosyns from the "null" position, since the grid is held negative under these conditions by the voltage drop in the 300 ohm cathode resistor. However, for strong signals, corresponding to relatively large angular displacements of the Autosyns (near 90° from the "null" position for example) the grid is driven positive and therefore conducts current through the 0.5 megohm resistor during part of each cycle. The 0.05 microfarad condenser is therefore charged (with the polarity indicated) to a voltage equal to the peak voltage drop across the resistor (perhaps 100 volts or more since the voltage between grid and cathode and the voltage across the 300 ohm resistor will be only a few volts, so the condenser voltage will be nearly equal to the peak voltage across a grid transformer secondary.) Then as the motor drives the "slave" Autosyn quickly back to the "null" position the condenser charge slowly leaks off through the 0.5 megohm resistor, so that the grid is held more negative than normal and therefore reduces the plate current below normal, thus causing the relay to open before the "null" position is reached. This "anticipation" effect compensates for the inertia of the moving system and for the time delay in the operation of the relay and gives the "slave" Autosyn an opportunity to coast into the "null" position without "overshooting." Note that both grids are similarly affected by the R and C combinations so that both relay coil currents are held below their normal or "null" value for a short time after the signal reaches its very small normal or "null" value.

The 2 megohm resistor and 0.1 microfarad condenser in the sketches of November 10, 1943, and November 17, 1943, have the same effect as described above except that both grids conduct current at the same time during a half cycle of signal voltage, while the grids in the first circuit described conduct during alternate half-cycles. The R and C combinations in some of the other sketches ** have an equivalent effect, though the explanation of the method of charging the condenser is slightly different for each different circuit arrangement.

** Two 2 megohm resistors and one 0.2 microfarad condenser in sketch of 10/1/43;
Two 1 megohm " " " 0.5 " " " " " 10/21/43.

(B) Motor Feedback to Cathode Circuit. ("Kick-out" effect due to feedback of motor voltage to cathode circuit): Referring to the sketches of October 21, 1943, November 10, 1943 and November 17, 1943, a 1000 ohm resistor is connected from each motor field terminal (or the corresponding relay terminal) to a common junction. From this common junction a connection is made to the cathodes of the tube, preferably through an adjustable resistance (shown as a 1000 ohm rheostat in sketches of November 10, 1943 and November 17, 1943.) Between the cathode and the "ground" (or negative battery terminal) a fixed or adjustable resistance of 500 to 2000 ohms is connected. The operation of this circuit is as follows: At "null" or for very small voltage signals, corresponding to small angular displacement of the "master" and "slave" Autosyns or "Potentiometers", *** all relay contacts are open and the total plate current (cathode current) of the twin-triode tube divides between two parallel paths from cathode to "ground". The first path is merely the usual cathode resistor of 500 to 2000 ohms. The second path includes the 1000 ohm rheostat in series with the series-parallel combination of the two 1000 ohm resistors, the motor fields, and the motor armature.

*** "Potentiometer" Control

The sketch of October 21, 1943 shows a method of getting a "signal" voltage from a pair of "potentiometers" or voltage dividers instead of from autosyns. One "potentiometer" serves as the "Master" control, and the other, driven by the motor, is the "Slave" or "follow-up." The 50 ohm resistor is intended to protect the "potentiometers" from excessive current supplied to the grid transformer for large displacements of the "Master" and "Slave" from "null".

When the signal voltage is sufficient to cause the relay contacts to close, the circuit from the positive terminal of the battery is connected to one of the motor fields and thus to one of the 1000 ohm resistors. This causes a reversal of current through the 1000 ohm resistor and the 1000 ohm rheostat, so that the current through the first path (the cathode resistor of 500 to 2000 ohms) is quickly increased. The corresponding increase of voltage drop from cathode to "ground" makes the grids more negative than normal, thus causing the plate currents to decrease and open the relay contacts after giving the motor a very brief impulse of power. This "kick-out" or motor feedback effect compensates for the inertia of the moving system and for the time delay in the operation of the relay and allows the "slave" and the associated actuator to be moved in very small "steps" or "nibbles", for precise positioning. Ideally the smallest "step" should be just sufficient to return the "slave" to the "null" position, assuming an initial displacement of "master" and "slave" just sufficient to cause operation of the relay. The "dead zone" or "inactive zone" or "null zone" under these conditions would correspond to twice the smallest "step" of the moving system.

Note that the "kick-out" (motor feedback) effect permits stable operation with a much narrower dead zone than would be possible otherwise. Also, the "kick-out" effect is useful for stabilizing the system after very small displacements of the "master" and "slave", while the R and C in the grid circuit require a much larger displacement before the condensers acquire enough charge to give an "anticipation" effect. Thus the combination of the two circuits as in the sketch of November 17, 1943 is quite effective for stability after both large and small displacements.

(C) Transient or Inductive Feedback from Motor Circuit: Referring to the sketch of November 17, 1943 the circuit can be arranged so that a small D-C voltage is inserted in series with one of the grid input transformer leads marked "Input from Autosyn" when the relay contacts close and is removed when the relay contacts open, so that a transient voltage is produced in the secondary of the grid transformer when the motor circuit is made or broken by the relay. The transformer connections can be arranged so that this transient voltage will increase the grid voltage (make the grids momentarily more positive than normal) while the direct current is increasing in the primary of the grid transformer just after the relay closes, and will decrease the grid voltage (make the grids momentarily more negative than normal) while the direct current is decreasing in the primary of the grid transformer just after the relay opens. Assuming an input signal just strong enough to cause the relay to close, the transient increase of grid voltage causes the plate currents to increase momentarily, thus closing the relay contacts more firmly just after the contact is made. This transient effect quickly becomes negligible as the direct current becomes steady in the grid transformer primary, so the motor feedback previously described under (B) then causes the relay to "kick out". Then the transient decrease of grid voltage causes the plate currents to decrease momentarily below the normal value, thus giving the relay a strong tendency to open the contacts fully just after the contact is broken. This transient effect again quickly becomes negligible as the direct current approaches zero in the grid transformer primary. The circuit then regains its normal sensitivity.

The sketches of November 30, 1943 and December 13, 1943 show means by which the small D-C voltage discussed above may be inserted in series with the primary of the grid transformer. In these circuits one of the wires of a cable connecting the "master" Autosyn rotor to the grid transformer primary also carries the motor current when the relay is closed, so that the voltage drop in the wire (corresponding to the motor current) is then in series with the Autosyn rotor and the transformer primary. For example, in sketch of November 30, 1943, the voltage drop in the wire marked (1) "Yellow" has the polarity indicated by the marks + and - while the relay is closed. This causes a direct current to build up in the grid transformer primary, as previously described, when the relay closes. In the sketch of December 13, 1943 the required

Inter-Office Correspondence

LEAR AVIA INC.

AVIATION INSTRUMENTS & ACCESSORIES

Memo To ..... Date January 12, 1944

From J. M. Roberts Branch .....

Subject .....

D-C voltage is provided by the voltage drop in the "Pink" wire No. 7, carrying the motor current when the switch and relay are closed.

If it is desired to provide this D-C voltage without depending upon the cable length it can be done by inserting a very low resistance in series with the motor circuit and connecting this resistance in series with the grid transformer primary.

End of this document

52-5

Inter-Office Correspondence

LEAR AVIA INC.

AVIATION INSTRUMENTS & ACCESSORIES

Memo To Mr. A. E. Page Date January 12, 1944

From J. M. Roberts Branch

Subject STABILIZING ELECTRONIC RELAY MOTOR CONTROLS

cc: Mr. R. A. Marsen

Dear Mr. Page:-

Attached are photostats of sketches by myself, dated August 10, 1943, September 11, 1943, October 1, 1943, October 21, 1943, November 10, 1943, November 17, 1943, and November 30, 1943; as well as a sketch by Oswald Ariagno, dated December 13, 1943, as you requested a few weeks ago.

The following is a brief summary of the methods of stabilizing these circuits:

(A) "Anticipation" Effect Due to R and C in Grid Circuit: This resistance and condenser combination in the grid circuit desensitizes the control circuit and broadens the "dead zone" ("inactive zone" or "null zone") as the "slave autosyn" or "slave potentiometer" quickly returns to the "null" position following a large angular displacement between the "master" and "slave". This method can prevent "overshooting" following large displacements, but has no effect on the sensitivity for small displacements.

(B) Motor Feedback to Cathode Circuit ("Kick-out" effect Due to Feedback of Motor Voltage to Cathode Circuit): This connection between the motor fields and the cathode desensitizes the control circuit and broadens the dead zone immediately after the relay closes, so that the relay opens quickly if the closing was due to a very small angular displacement of the "master" and "slave". However, the relay remains closed if the displacement is large enough to counteract the desensitizing effect. This method gives stability for small displacements and permits the use of a very narrow dead zone.

(C) Transient or Inductive Feedback From the Motor Circuit: This transient voltage, induced in the grid transformer immediately after closing or opening the relay, increases the sensitivity and increases the relay contact pressure momentarily after the relay closes, and then has a negligible effect if the relay remains closed for an appreciable time. Then, when the relay opens as the "slave" returns near the "null" position, the reversed transient voltage desensitizes the circuit and broadens the dead zone momentarily, causing the relay to open fully with a "snap" action. The sensitivity then quickly becomes normal again.

COMBINATIONS OF STABILIZING METHODS

(A) and (B) Together: This combination provides stability with a narrow dead zone and can prevent overshooting for either large or small displacements of the "master" and "slave", except when the "master" is stopped suddenly

Inter-Office Correspondence

LEAR AVIA INC.

AVIATION INSTRUMENTS & ACCESSORIES

Memo To Mr. A. E. Page Date January 12, 1944

From J. M. Roberts Branch

Subject STABILIZING ELECTRONIC RELAY MOTOR CONTROLS

after having been turned at a speed just sufficient to bring the "slave" up to its full speed. The slight overshooting in this case is quickly corrected, however.

(A) and (C) Together: This combination gives stability with a narrow dead zone but may allow overshooting under some conditions. (Tests not completed on this.)

(B) and (C) Together: This combination gives stability with a narrow dead zone but may allow overshooting following large displacements, unless some "nibbling" or "stepping" (rapid opening and reclosing of the relay) is permitted as the "slave" returns to "null" following a large displacement.

(A), (B) and (C) Together: This combination is similar to (A) and (B) in its performance, except that more "snappy" action of the relay is obtained when (C) is used. This makes adjustment of the relay less critical than is required for (A) and (B) alone.

The above summary merely describes the behavior of these stabilizing methods. An explanation of the principles of operation is given in some detail on the attached sheets. If further information or explanation is desired, please let me know.

Yours very truly,

Jean M. Roberts

Jean M. Roberts

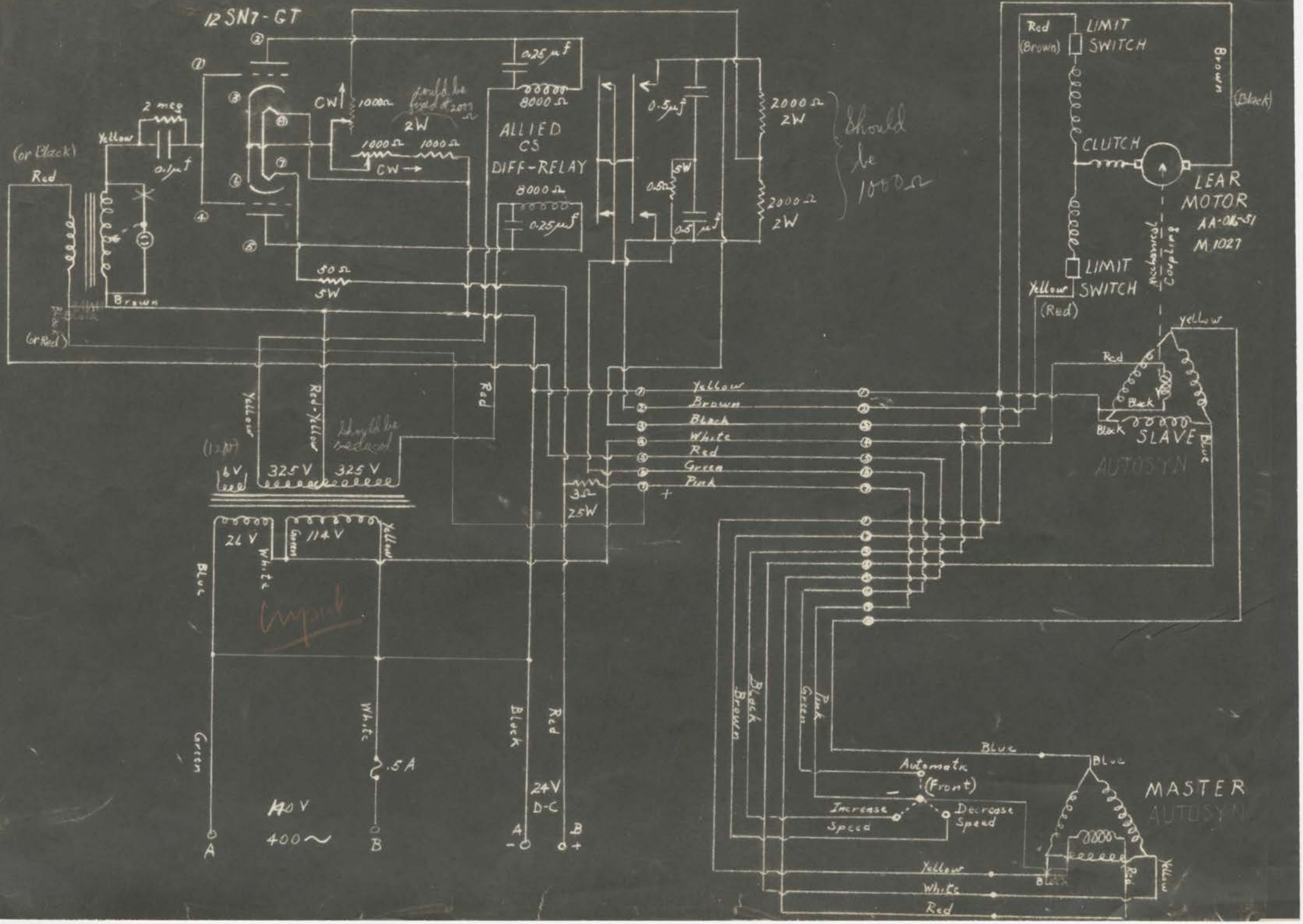
JMR:BM

End of this document

Changed into Trans Contr 12-14-43 (See circuit of 11-10-43)

Circuit for Laboratory Demonstration Model of "Electric Head" Control for H.S.P. Governor.

C.A. 12-13-43 J.



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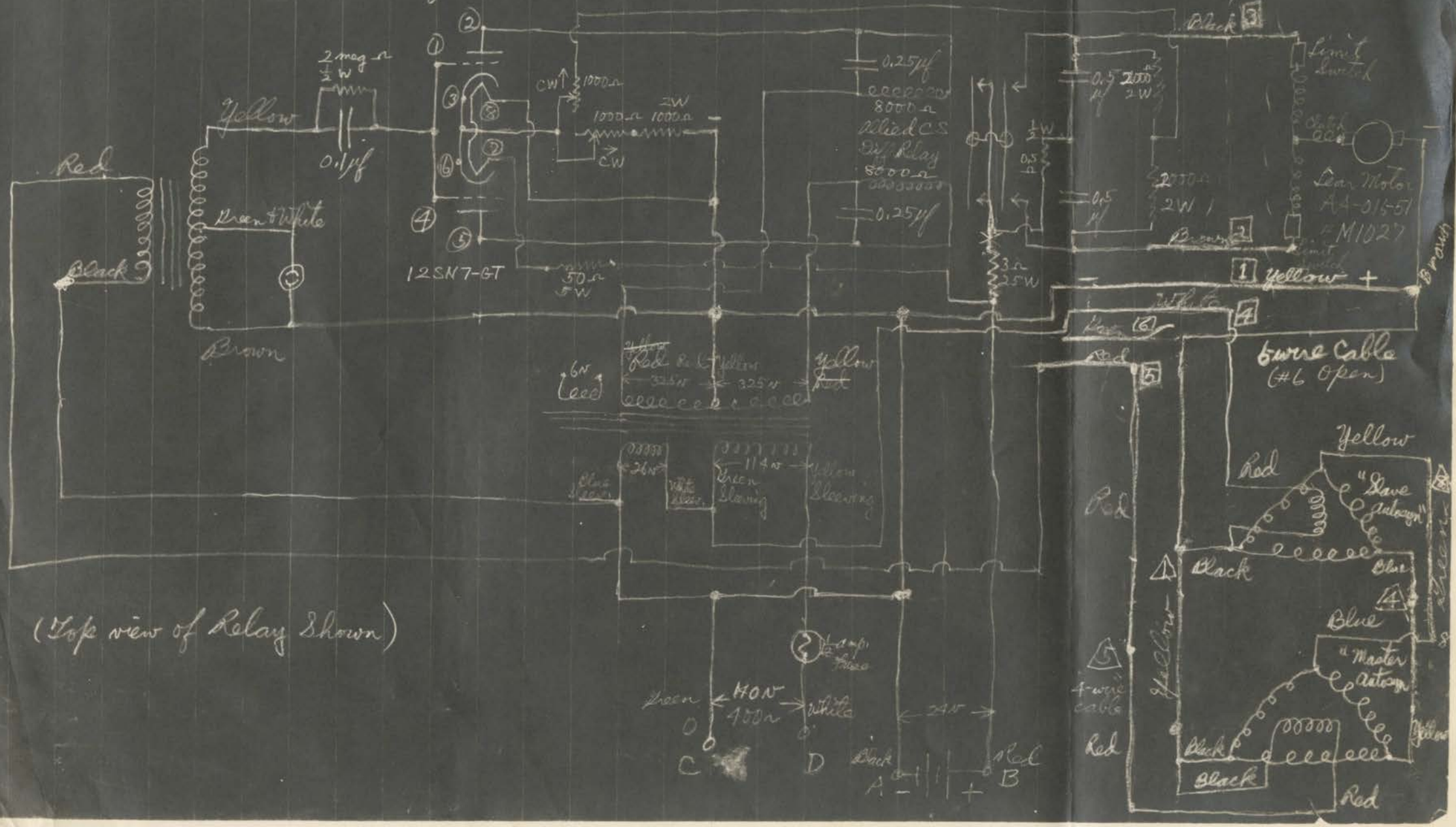
See copy made by Olivagno, 12-13-43 & 12-14-43

MOK 11-30-43

Revised Circuit of "Electric Head" for Steering Control



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Ld 101

Mr. W. P. Lear - Learcal

November 17, 1943

R. A. Marsen

N. Y. Office

Air Mail

Dear Bill:-

Here is a circuit diagram of the present form of the circuit for the Electric Head which I described to you last night.

The circuit works very smoothly, giving 10 nibbles per division on a scale corresponding to 0-100 over 180 degree arc, which means about 6 nibbles per mechanical degree of arc. Hamilton saidthat a nibble corresponding to 5 RPM is satisfactory. However, the nibbles we now have correspond to about 2 RPM or possibly 1 RPM, depending upon how the thing is set up with the governor. An AA-016 motor is used in our tests. We trust that this will be of sufficient size to actuate the gearing for the extreme temperature conditions. However, if this motor is too small I have no doubt that an AA-100 motor will suffice; the circuit, of course, being identical.

The circuit is essentially the same as the ones you already saw here. The .25 mfd. condenser shunted by the 1 megohm resistor in series with the secondary of the grid transformer "T" gives the anticipation. You will note a small neon tube "N" across this secondary to protect the transformer from a possible damaging voltage surge.

A kickback circuit is provided to give small nibbles and comprises the two 5,000 ohm resistors R_1, R_1, the center of which is fed back to the 10,000 ohm grid bias resistor R_2. This operates when the relay contacts are engaged to connect the battery to further bias the grid and provide the small nibbles. A 10 mfd. electrolytic is placed across each side of the motor to make the motor essentially a non-inductive load on the relay and circuits -- reducing the arcing.

The CS relay is adjusted so that one armature a-a comes in first when energized and connects the motor to the battery through a small resistor such as 3 ohms. This limits the initial current to the relay and protects the contacts and also limits the top speed of the motor for the small nibble. This permitsthe very fine nibble which we have finally evolved. When the signal is sufficiently strong the second armature b-b comes in, which short circuits the 3 ohm resistor and puts the motor directly on line.

Thus the combination of the anticipation, kickback, and differential relay-resistor connection gives a very smooth control which is desirable and required for the Electric Head. In fact, it is so sensitive of nibble and the null is so narrow that we are putting on a vernier type tuning head as is used in radios for the setting control at the transmitter autosyn.

We have ordered a special AA-016 motor from Piqua, designed to operate at a top speed of 8,000 RPM, with the hope that it would be sufficiently powerful for the job and require a smaller gearing ratio than is at present used with the high speed motor.

M

Please let me know whether we should await the special motor and make the reduced gearing load before presenting the solution to Hamilton; or shall we whip it up with what we have and send it up for demonstration at this stage? Please bear in mind that they have other electrical and mechanical heads under test for this job and we certainly want to present a solution that is far superior to anything they saw for this purpose.

We are making excellent progress on the Duplex Control and should have the actual prototype model all completed by about December 1; namely, in two weeks. There are lots of parts and details that have had to be designed and made.

Best personal regards.

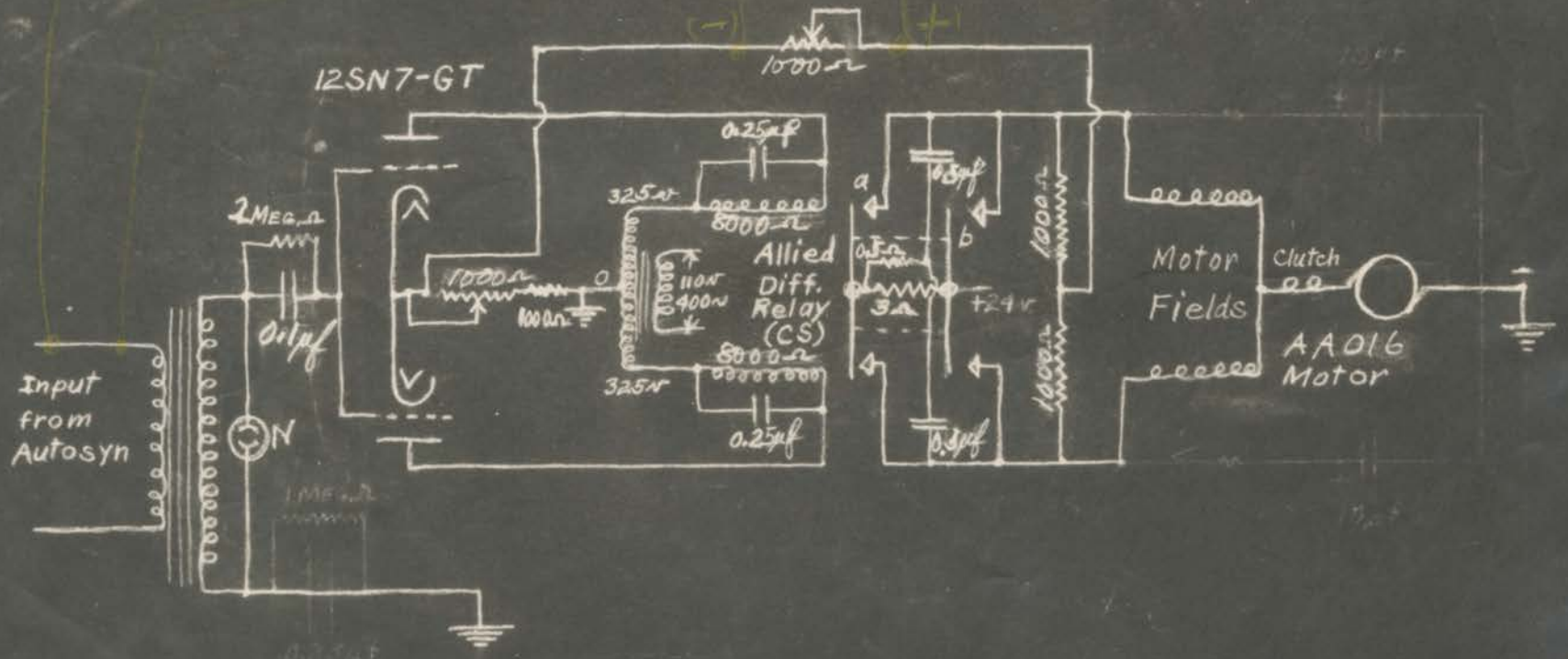
Sincerely,

R. A. Marsen

RAM:BM
Encl

End of this document

PROPOSED CIRCUIT FOR "ELECTRIC HEAD" CONTROL



J.M.R. 11-17-43

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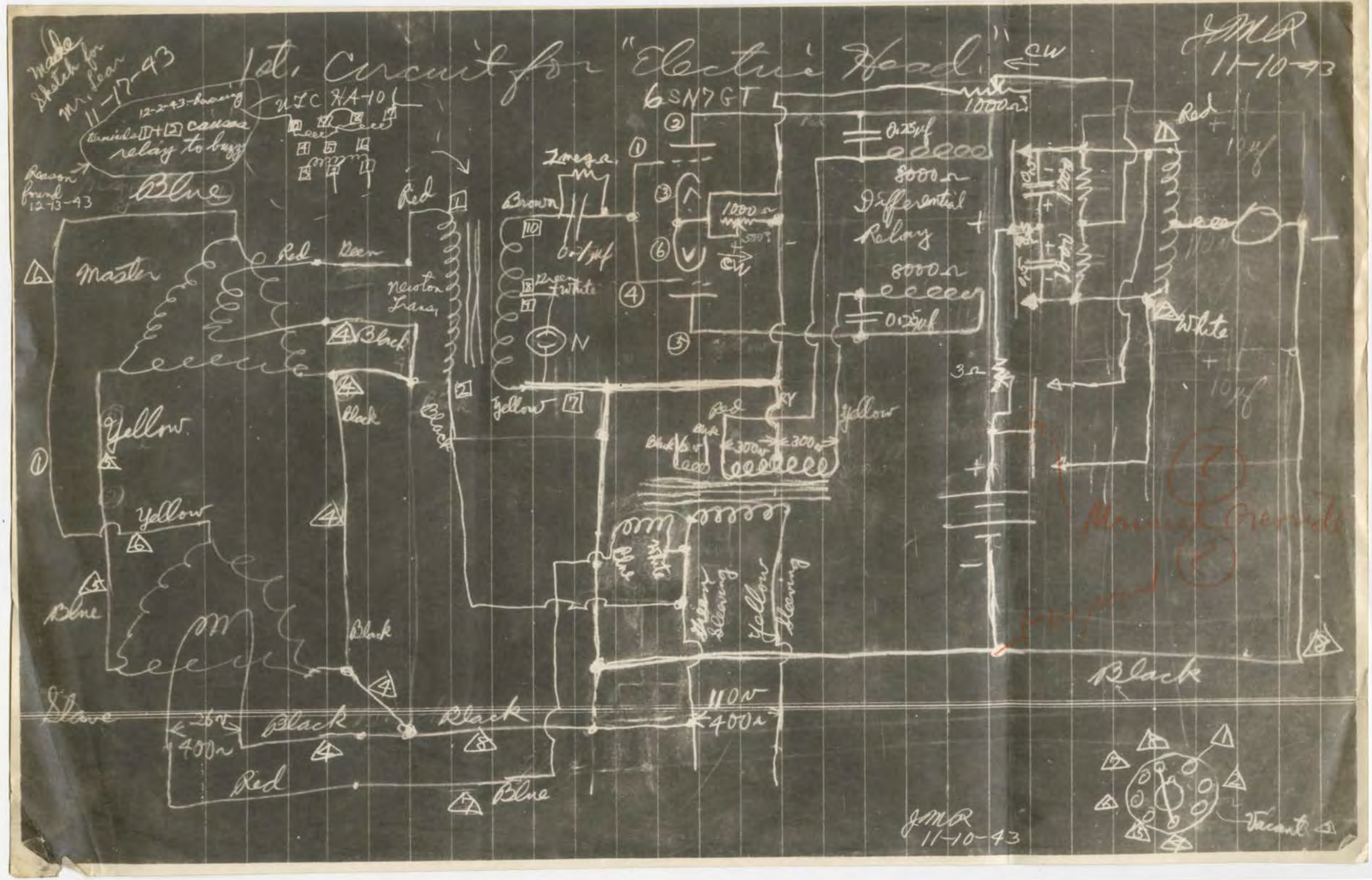
Made Sketch for Mr. Lear 11-17-43
1st. Circuit for "Electric Head"
12-2-43-Drawing
Contacts 1 + 2 causes relay to buzz
Reason found 12-13-43
Blue
Red
Brown
Red
Black
Master
Newton trans.
Yellow
Black
Yellow
Blue
Black
Slave
Black
Red
Blue
Omega
0.1 µf
White
N
6SN7GT
1000Ω
0.25µf
8000Ω
Differential Relay
8000Ω
0.25µf
1000Ω
CW
CW
Yellow
Red
Black
300Ω
300Ω
KY
White
Blue
Steering
Yellow
Steering
110V
400Ω
26V
400Ω
Red
Blue
JMR 11-10-43
JMR 11-10-43
Red
1µf
White
10µf
3Ω
Black
Vacant

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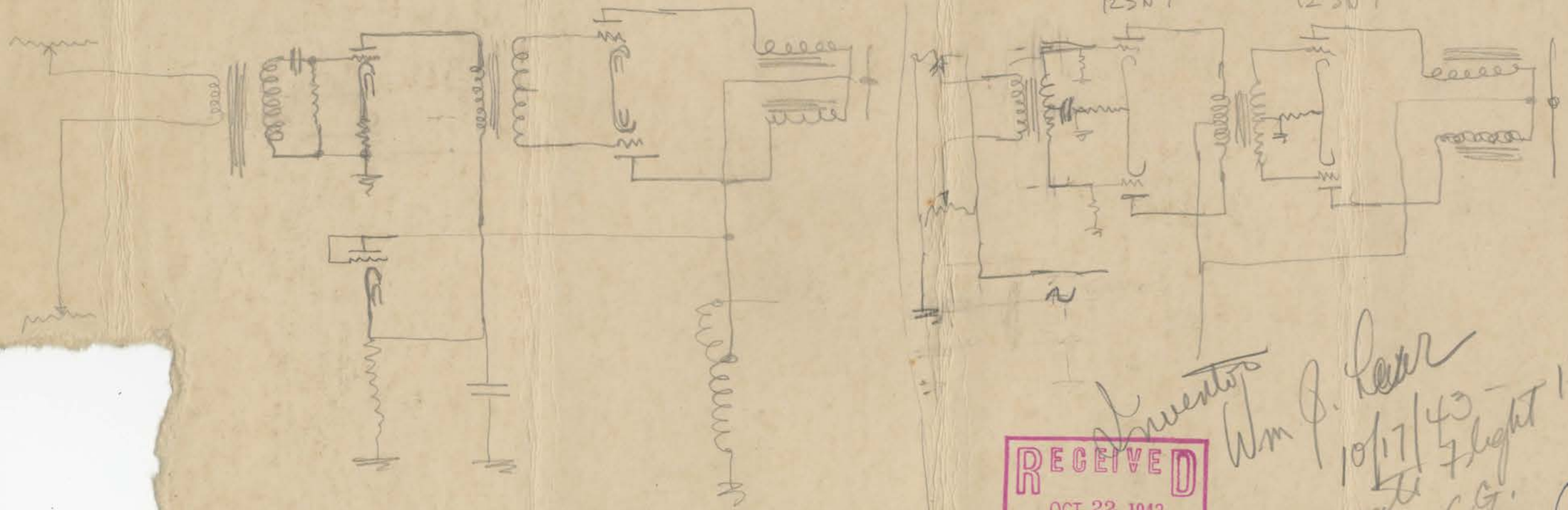


Inventor
Wm J. Lear
10/17/43
Enroute Flight 18
LA to CG.

RECEIVED
OCT 22 1943
LEAR AVIA INC.
NEW YORK OFFICE

YOUR PLAC

If you desire to retain this

plane at intermediate station

on cushion of the seat whic are occupying.

Sorry . . . this seat is

OCCUPIED

by a passenger who boarded the plane previously

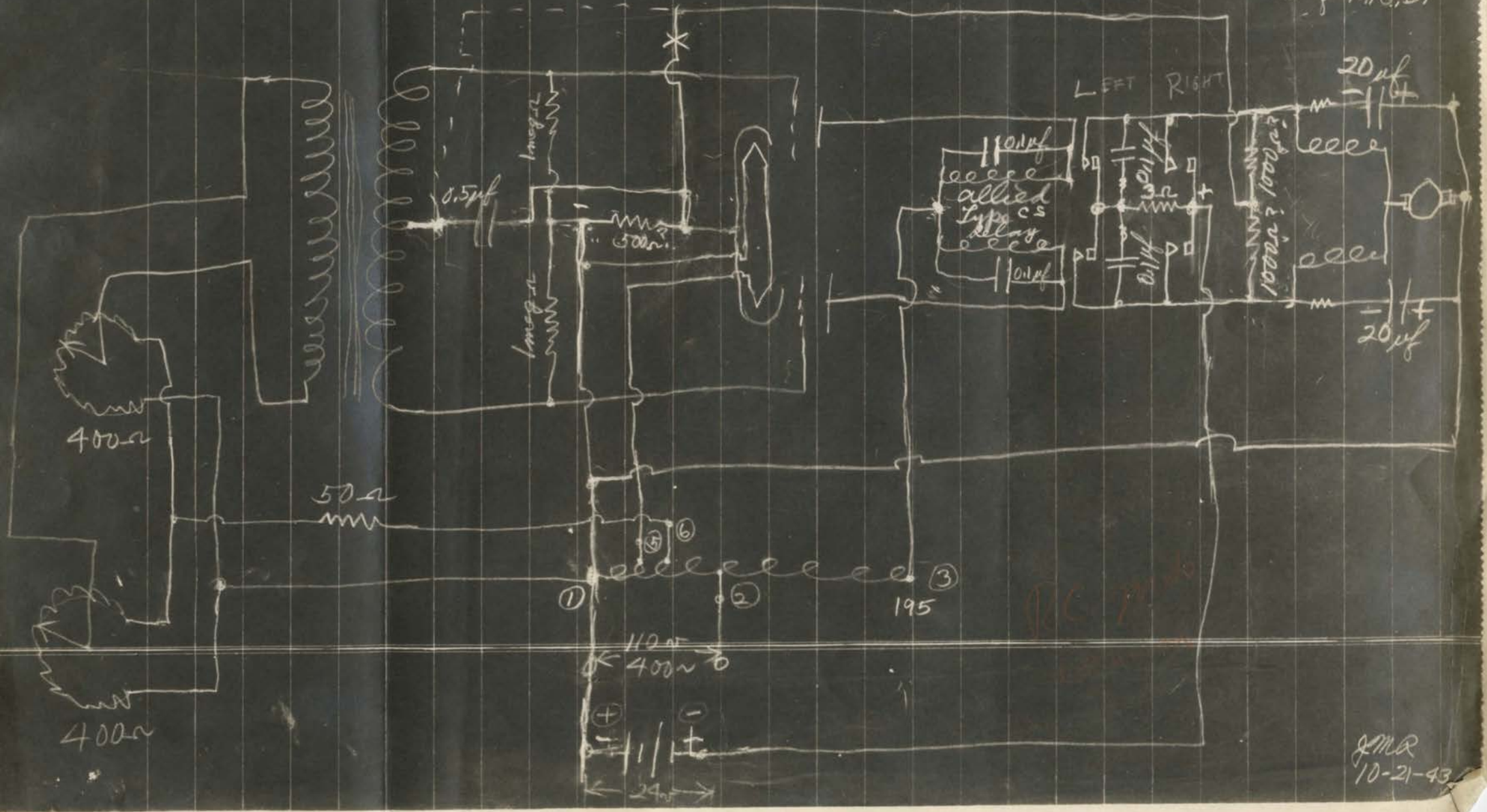
Form No. Pas.-472 (TWA 2-396—12-42)

End of this document

Input = 0.11 amp. 400~
at 110~ on model 433 Vm.

10-21-43
J.M.R

See layout of 10-22-43 using battery feedback circuit of M.G.B.



J.M.R
10-21-43

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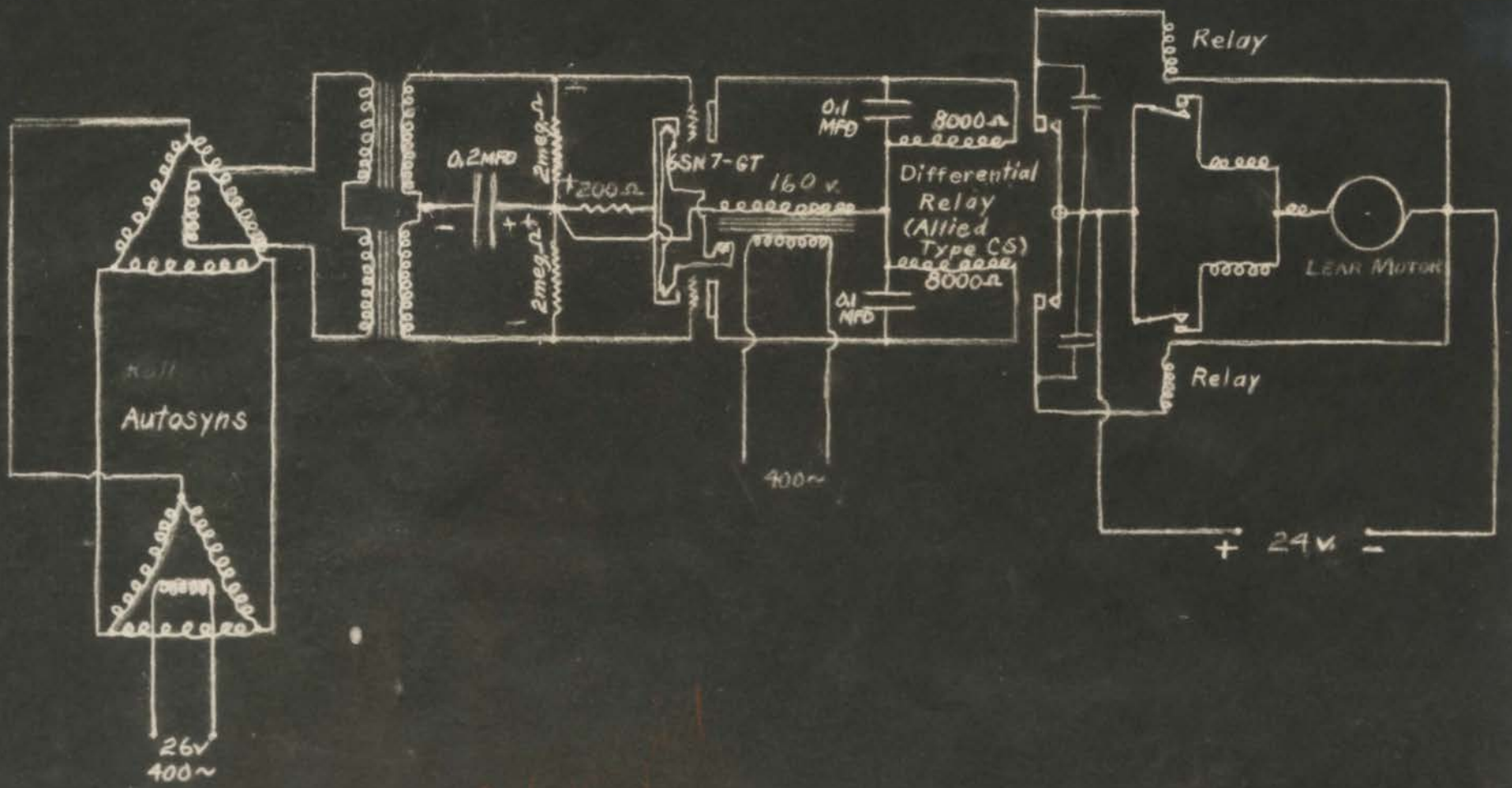
Revised Midget

ELECTRONIC CONTROL CIRCUIT

WITH DIFFERENTIAL RELAY AND AUXILIARY RELAYS



J.M.R. 10-1-43

To California

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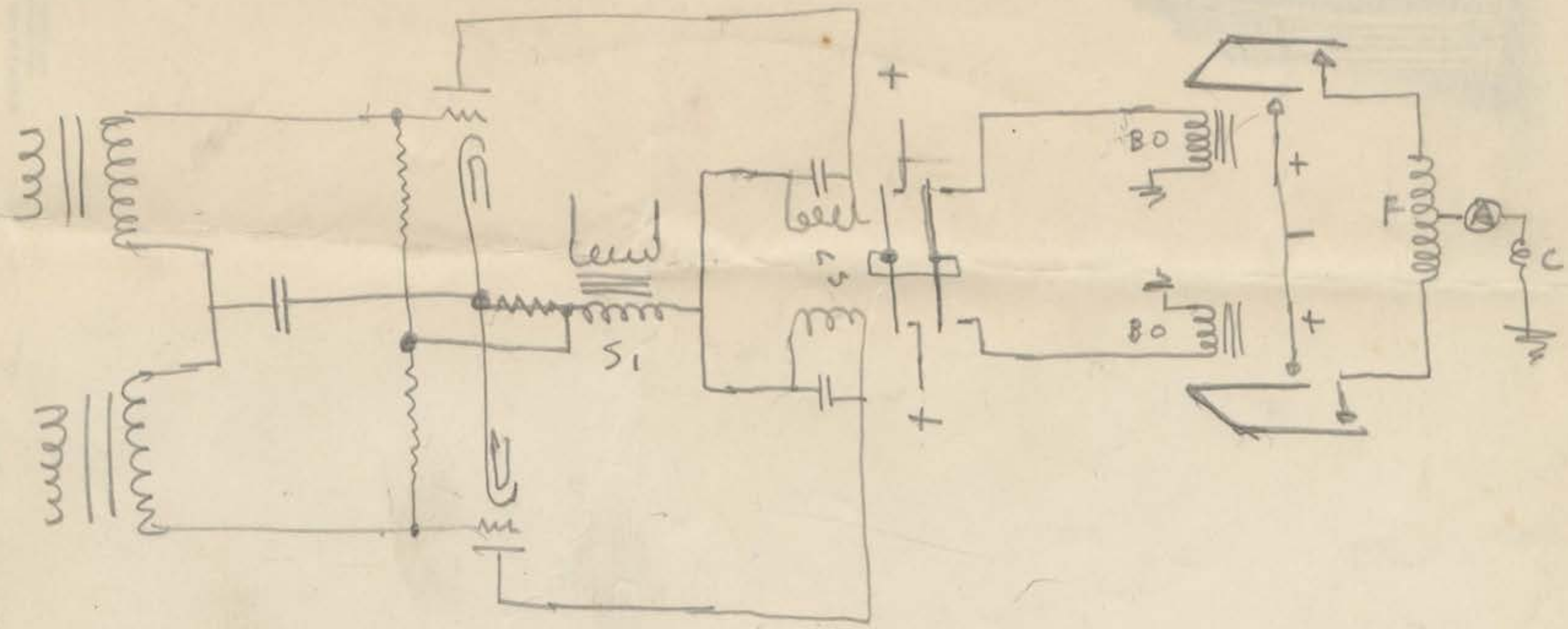


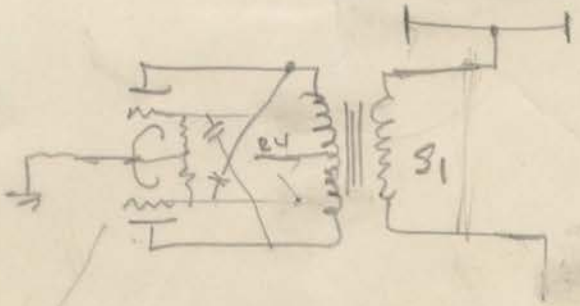
WPL
to EAM
9/27/43
Zapp

0.0.3
003

2 BO - 2@ 4oz = 8
1 CS - 1@ 7oz 7
15 oz

Krumrine

9



8000
.003
24

.003
.003
.000009
.872
.150

12

.6

WICKERSHAM 2-4400

CABLE ADDRESS: "LEXTEL"

HOTEL LEXINGTON

LEXINGTON AVENUE AT FORTY-EIGHTH STREET

NEW YORK CITY

CHARLES E. ROCHESTER
VICE PRESIDENT AND
MANAGING DIRECTOR

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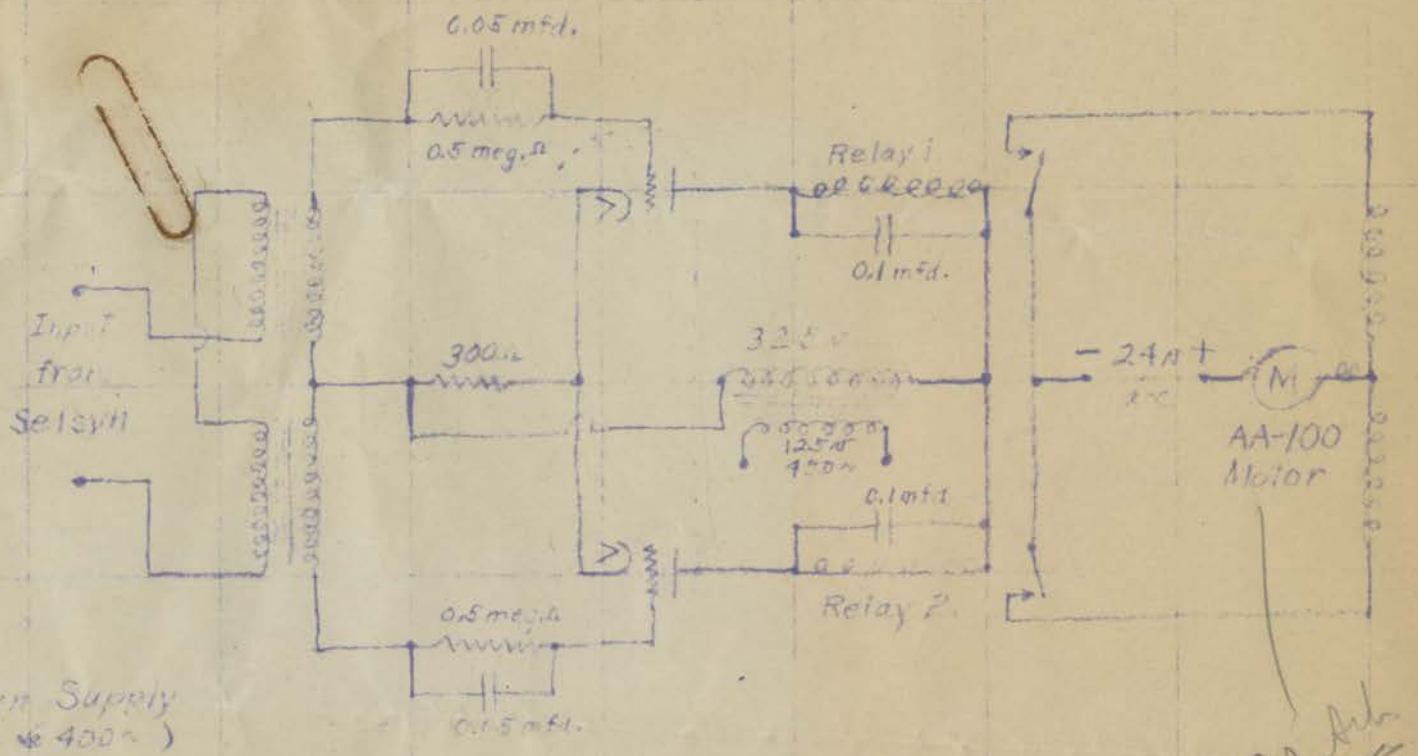

Midget Control Circuit

(Schematic)

Anticipation Grid Circuit

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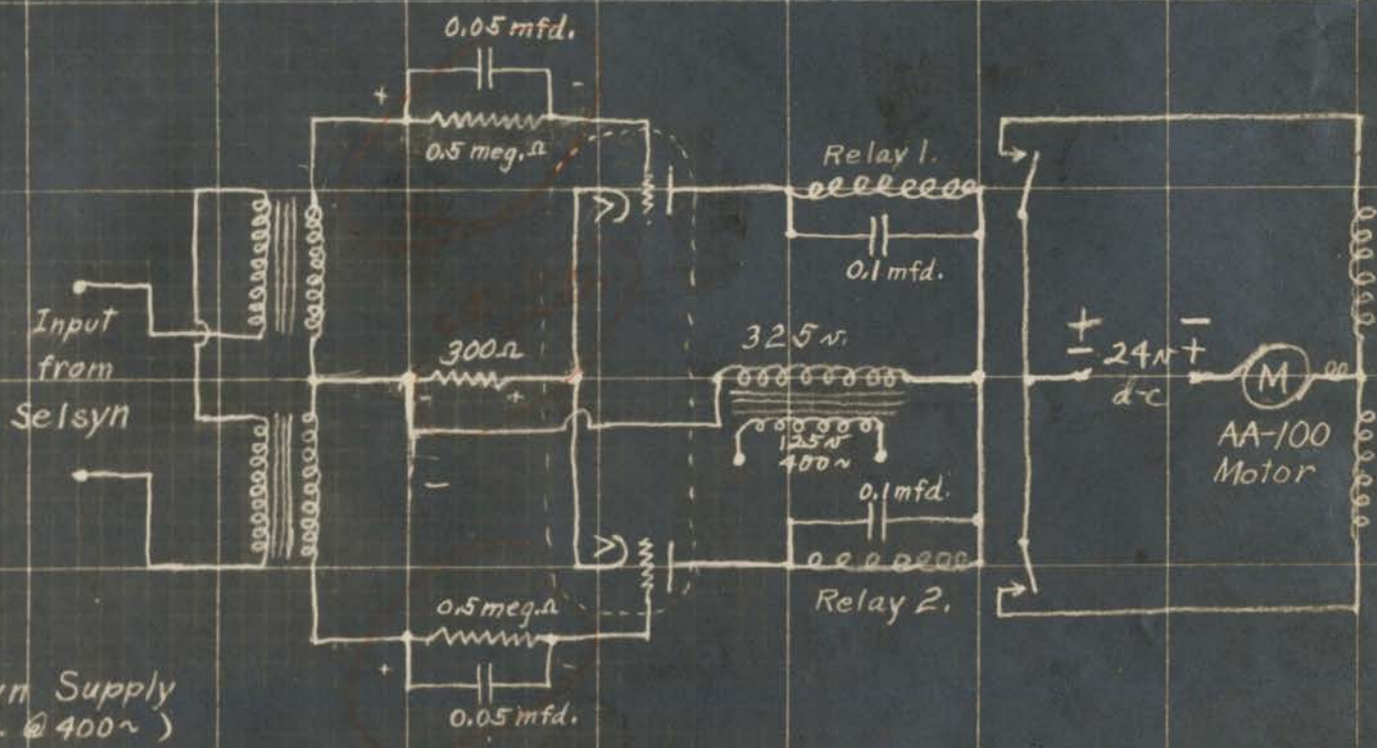

Original Midget Control Circuit

(Schematic)

JMR
9-11-43

JMR
9-11-43

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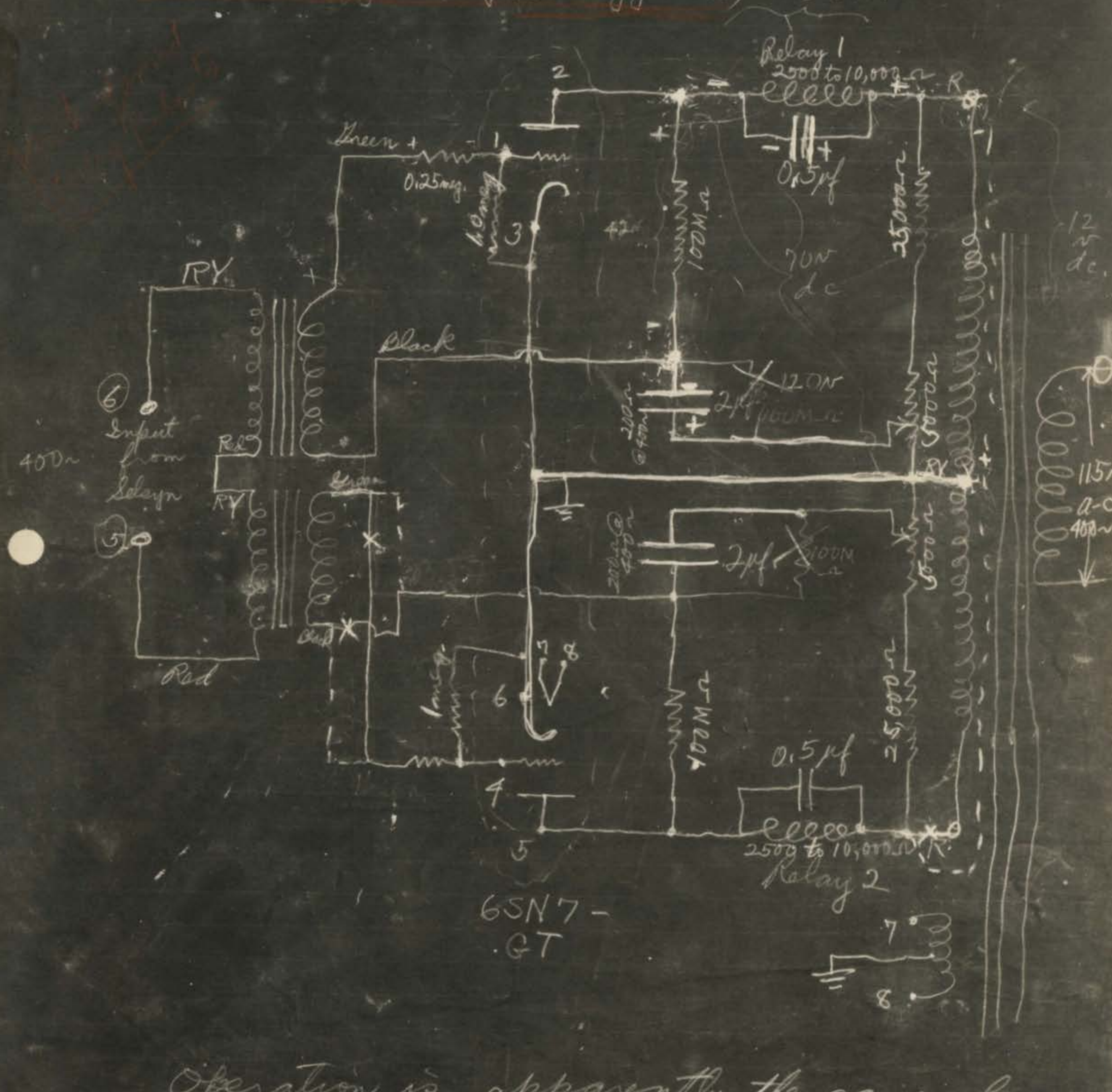
Copied on page (10) of notebook 9-14-43 JMR

8-10-43 JMR

autosyn
~~Selsyn~~ Relay Motor Control
(Built by M. G. Baynard, using grid condenser circuit suggested by H. Nygaard)



Operation is apparently the same for either the "black" or "red" connections.

8-17-43 The 1 megohm resistors in parallel with the grids have a negligible effect on the operation. Omit

9-3-43. Less sensitive with grid transformer primaries in parallel. (Overloads Selsyn)

End of this document

R 1. Different specific means of anticipation, & effect for "anti-hunt"?

R 2 Patent theories as to broad concept of (1)

3 Effect of use of clutch (and brake) in ~~straight~~ Learlson Control etc. Advantage as anti-hunt?

R ? re Eddy current disk? (1). How does it work?

Circuit R-C Plate Wiggard.

" R-C Grid

" Kickback A—Wiggard C—Roberts

" Potentiometer

" Inductive Feed Back.

Roberts

Re inductive feed back

Note

Effects achieved by reversing trans wdgs. re polarity or by reversing connections to reverse direction of voltage drops

---

Potentiometer Control

Mentioned by instructor at Newark. Barnard may have used this sometimes in Sensitive Control, See also "Industrial Instruments"

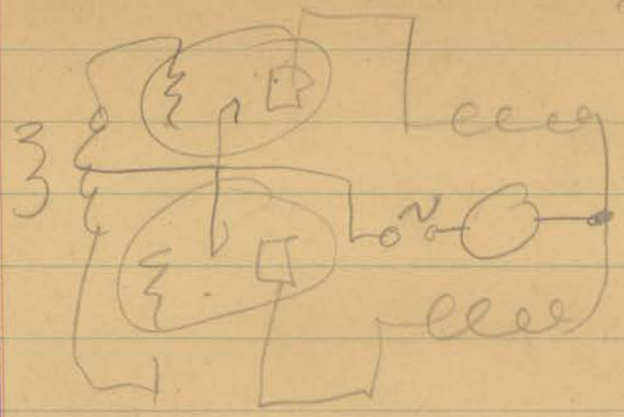
Reactance tube

See "Industrial Instruments for Meas. & Control" Rhodes 1st Edition

Barrand & Roberts & grid plate

Pure sel control

doesn't show relays



(B) Condenser + R in grid circuit. Give anticipation effect re anti-hunting

(A)

Broadening Null" - circuit sensitivity is inversely proportional to amount of displacement.

Potentiometer control null current

Selsyn Motor Control Sheet 8-10-43 JMR

Midget Control Act also JMR 9-11-43

Broaden Null

Shift Null - i.e. ~~one~~ actuate relay ~~more~~ less sensitive than in adjac due to C charge

anti hunt in plate circuit

N has aircuit re Null Shift

R Sketch - dated 11-10-43
" " 10-1-43 - Re California
" " 10-21-43.

C builds up on displacement
C can't discharge as fast as E_g drops
∴ Overbalances signal voltage and thus reduces E_g below critical before null is reached. Step by step then - due to leak etc.
Condenser charge is proportional to, displacement amount of and also to length of time of displacement

Condenser + resistance sig determined by Type of control re speed of follow-up

Barnard suggested grid leak condensers - according to R

N acc to R Re 8-10-43 aircuit - Tests showed that grid current also affected C charge; not only plate I - This aircuit is disadvantage re desensitizing of response. Cir ait has null shift feature. E_g drop across one relay makes grid E more negative. Non-operating relay becomes more sensitive than operating.

Sketch - JMR 11-17-43

N can't limit T secondary voltage but doesn't adversely affect anticipator. Merely voltage protector against high voltage in control circuit.

"varistor"

Alternatives ① Generator driven by motor

② Transient inductive effect

@ copper disc - control speed in coil

Speed changes - inductive transient effect

R says N first suggested "kick-back" - Hansen somewhat similar effect with rectified A.C. is shown in "Industrial Measurement and Control"

Roberts

Sketch dated 11-10-43
10-1-43 re Calif.
10-21-43
8-10-43
11-17-43
9-11-43

Short description

Distribution effect - grid leak + C
Battery - tuning out effect

Preferably both with reference to one circuit.

[illegible]

A as " may have put features per se

N devised R found grid rectifying action in tests

Null shift - only in plate anticipation circuit

Keck off desensitizes tube circuit by making E_g more (−) when relay contacts close.

C // to relay coil smooth out hum

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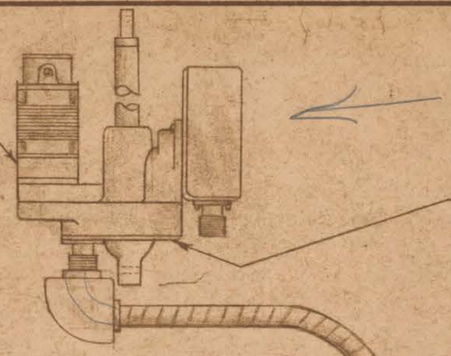

LEAR "FASTOP" CLUTCH
WITHOUT BRAKE

MODEL
440B, ISSUE 2
WING FLAP CONTROL
OVERALL GEAR RATIO - 86.8:1
SCREW - 10 THDS/IN., 4 LEAD
GEAR RATIO BETWEEN SCREW
& FLEX. SHAFT TAKE-OFF - 15.8:1
GEAR RATIO BETWEEN MOTOR
PINION & FLEX SHAFT TAKE-OFF - 5.5:1
BUDD PC. 1-82-214

MODEL
711A-11, ISSUE 3
FLEXIBLE SHAFTING
BUDD PC. 1-82-210

MAX. LOAD - 31.2 LB. IN.
NO LOAD SPEED - 3400 R.P.M.
FULL LOAD SPEED - 1660 R.P.M.
NO. OF TURNS FOR 9 1/8" STROKE - 356

MODEL
760A, ISSUE 2
2 TO 1 "T" DRIVE
GEAR RATIO - 2:1
BUDD PC. 1-82-212

MODEL
711A-9, ISSUE 3
FLEXIBLE SHAFTING
BUDD PC. 1-82-208

MODEL
830B, ISSUE 2
TRANSMISSION WITH
INDICATOR & HANDCRANK.
MAIN GEAR RATIO - 8:1
INDICATOR GEAR RATIO - 160:1
BUDD PC. 1-82-213

MAX. LOAD - 32.8 LB. IN.
MAX. SPEED - 6800 R.P.M.
TOTAL Nº OF TURNS - 7 1/2

BUDD PC. 1-50-032

MODEL
711A-10, ISSUE 3
FLEXIBLE SHAFTING
BUDD PC. 1-82-209

MAX. LOAD - 31.2 LB. IN.
NO LOAD SPEED - 3400 R.P.M.
FULL LOAD SPEED - 1660 R.P.M.
NO. OF TURNS FOR 9 1/8" STROKE - 356

LEAR "FASTOP" CLUTCH
WITHOUT BRAKE

MODEL
440B, ISSUE 2
WING FLAP CONTROL
OVERALL GEAR RATIO - 86.8:1
SCREW - 10 THDS./IN., 4 LEAD
GEAR RATIO BETWEEN SCREW
& FLEX SHAFT TAKE-OFF - 15.8:1
GEAR RATIO BETWEEN MOTOR
PINION & FLEX SHAFT TAKE-OFF - 5.5:1
BUDD PC. 1-82-214

NOTE~
MINIMUM RADIUS OF BENDS
IN FLEXIBLE SHAFTING - 20 IN.

NOTE~
ALL PERFORMANCE FIGURES ARE
FROM CALCULATED DATA BASED
ON LOADS ENCOUNTERED AT 90 M.P.H.

ALTERATIONS

1. ADDED NOTE THAT NO BRAKE IS USED CO# 3449 9-9-42 R.R.
2. CORRECTED FLEX. SHAFT LOADS & GEAR RATIO OF ACTUATOR - SHAFTING WAS C-1402S-W. CO# 3770 - RR. 10-21-42
3. MODEL NOS. 711B-10B, ISSUE 3, 711A ISSUE 2, 760A ISSUE 2, 440B ISSUE 1 WERE PART NOS. C17061 ISSUE 5, C16740 - ISSUE 4, C17060 ISSUE 5 & D17062 - ISSUE 4 RESPECTIVELY CO# 4350 1-27-43 R.R.
4. REVISED ISSUE NOS. ADDED BUDD PART NOS. 2-26-43 R.R.
5. ADDED CUSTOMER PART NOS. 3-11-43 M.A.

P264

QTY	USED ON

MATERIAL
FINISH
SCALE None
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: DECIMALS ±.003 FRACTIONS ±.010

TITLE PHYSICAL LAYOUT OF WING FLAP CONTROL

DRAWN BY R. DILL
DATE 8-11-42
CHECKED BY
APPROVED BY

DRAWING NO. C17062-A
ISSUE 6

SUPERSEDES ALL PRINTS PRIOR TO 2-26-43

LEAR AVIA, INC.
PIQUA, OHIO U.S.A.

Printed on
K & E Paper 2195-L
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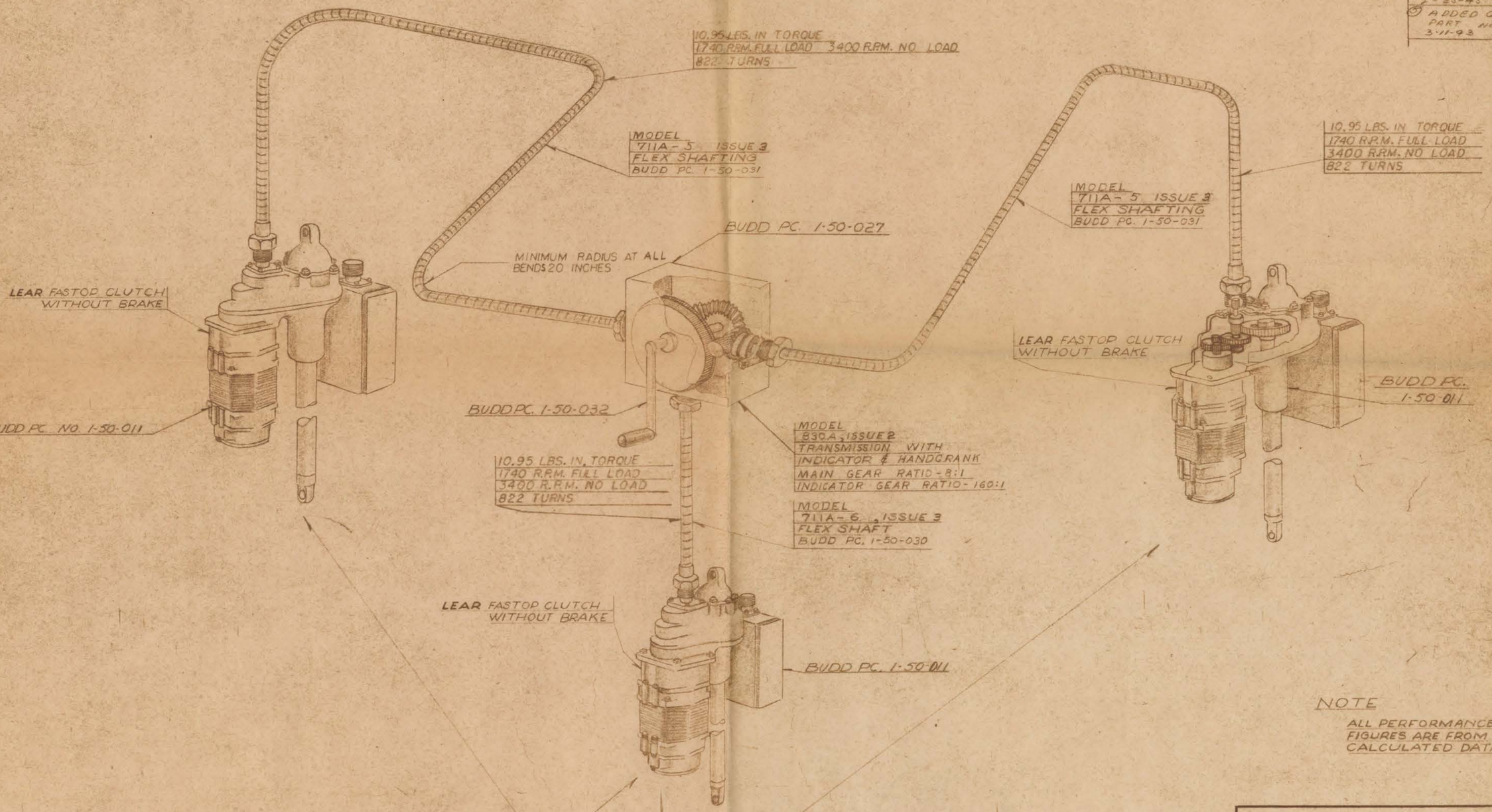
ALL LOADS GIVEN ARE FOR RAISING LANDING GEAR WITH MOTOR

ALTERATIONS
2 CORRECTED LOADS ON SHAFTING C157940W To C157940A MIN. RAD. 20 INCHES IN FLEX SHAFTING CHANGE IN GEAR RATIO C.O. 3756 10-21-42 T.S.
3 MODEL NOS. 440A ISSUE 1, 830A ISSUE 1, & 711A ISSUE 1 WERE PART NOS. D14121 ISSUE 5, C17663 ISSUE 3 & C13948 ISSUE 4 RESPECTIVELY C.O.#4349 1-27-43 M.R.
4 ADDED DASH NO. & CUSTOMERS NO. TO FLEX SHAFTING CORRECTED ISSUE NOS. 2-25-43 M.R.
5 ADDED CUSTOMERS PART NOS. 3-11-43 M.A.



NOTE

ALL PERFORMANCE FIGURES ARE FROM CALCULATED DATA.

MATERIAL	
FINISH	SCALE NONE
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: DECIMALS ±.003 FRACTIONS ±.010	
TITLE	PHYSICAL LAYOUT OF LANDING GEAR DRIVING MECHANISM
DRAWN BY MYKYTIUK	DRAWING NO. C 170666 ISSUE 6
DATE SEPT 10, 1942	
CHECKED BY	
APPROVED BY	
SUPERSEDES ALL PRINTS PRIOR TO FEB. 25, 1943	LEAR AVIA, INC. PIQUA, OHIO U. S. A.
Q'TY / USED ON	

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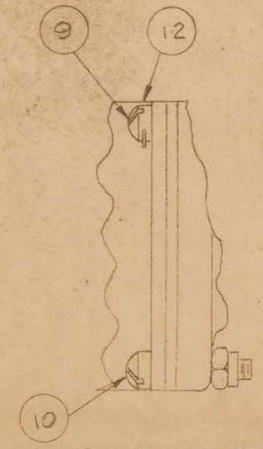
Nº	PART Nº	DESCRIPTION	REQ'D
1	A16054-AS	ASSY, IDLER PINION & MITER GEAR SHAFT	1
2	B8243-AS	ASSEMBLY TAKE OFF SHAFT	1
3	C8320-N	HOUSING, GEAR	1
4	C16015-N	COVER, GEAR HOUSING	1
5	D18282-AG	ASSEMBLY, DD-20 24V MOTOR	1
6	20071-P	PLUG, AN 895-70	1
7	20068-S	BOLT, AN60-4-12	4
8	A4487-S	NUT AN365-428 STOP	4
9	A20030-S	SCREW, AC500A8 10	2
10	20133-S	SCREW, AC 500 - 8 - 14	2
11	A15318-S	NUT., AN 365-832 STOP	2
12	A9041-W	WIRE, Nº 22 BRASS CAD. PL. SAFETY	13 IN
13	20074-S	SCREW, AN501A-10-12	2

Nº	PART Nº	DESCRIPTION	REQ'D
14	A18854-H	GEAR, "L-99 MITER	1
15	A9077-S	KEY, WOODRUFF #202	1
16	A4622-H	PIN, GROOVE 3/32 DIA. X 5/8 LONG	1
17	A18561-S	SPACER SLEEVE	1
18	A8508-H	WASHER, THRUST	1
19	A21985	NAME PLATE, MODEL 200A	1
20	12493	SCR 8/N. #00X 1/8 LG. TYPE PK U.	2

ALTERATIONS

1. ITEM #5 WAS C8926-AG C.O. 3625 C.H. 7-21-42
2. REVISED PER NEW DESIGN, ADDED ITEMS #16, 15 & 14 C.O. 3708 W.B. 10-13-42
3. ADDED ITEMS #17 & 18 C.O. 4082 M.K.S. 11-27-42
4. ADDED ITEM #19 NAME PLATE, & ITEM #20 SCREWS. ADDED NOTE 6. C.O. NO. 5289 3-7-43. H.I.T.



VIEW B-B

SECTION A-A

NOTE:
LUBRICATE PER LEAR SPEC. A15273-QL

NOTE
MASK FINISHED SURFACES AND PAINT PER LEAR SPEC. A18004-J

NOTE:

MOTOR ROTATION	OUTPUT ROTATION
WHEN FACING MOTOR PINION, PRONGS	WHEN FACING OUTPUT SHAFT, PRONGS
AC-CLOCKWISE	AC-CTR. CLOCKWISE
CB-CTR. CLOCKWISE	BC-CLOCKWISE

WEIGHT POUNDS	
EST.	10
ACTUAL	

RATIO 101.5 TO 1
250 / 125
600

QTY	NEXT ASSY	DWG. No.	MODEL
1	C16216	D14032	200A

USED ON

MATERIAL AS NOTED
FINISH AS NOTED SCALE FULL
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: DECIMALS ±.003 FRACTIONS ±.010

TITLE ASSEMBLY, DD-20 MOTOR & GEAR REDUCTION

DRAWN BY L. Thompson
DATE 10-19-42
CHECKED BY
APPROVED BY

DRAWING NO. C 15439-AS ISSUE 6

SUPERSEDES ALL PRINTS PRIOR TO 3-7-43.

LEAR AVIA, INC.
PIQUA, OHIO U.S.A.

P.L. 1207

QTY	USED ON

Printed on K & E Paper #195-L D. B. P. Co.

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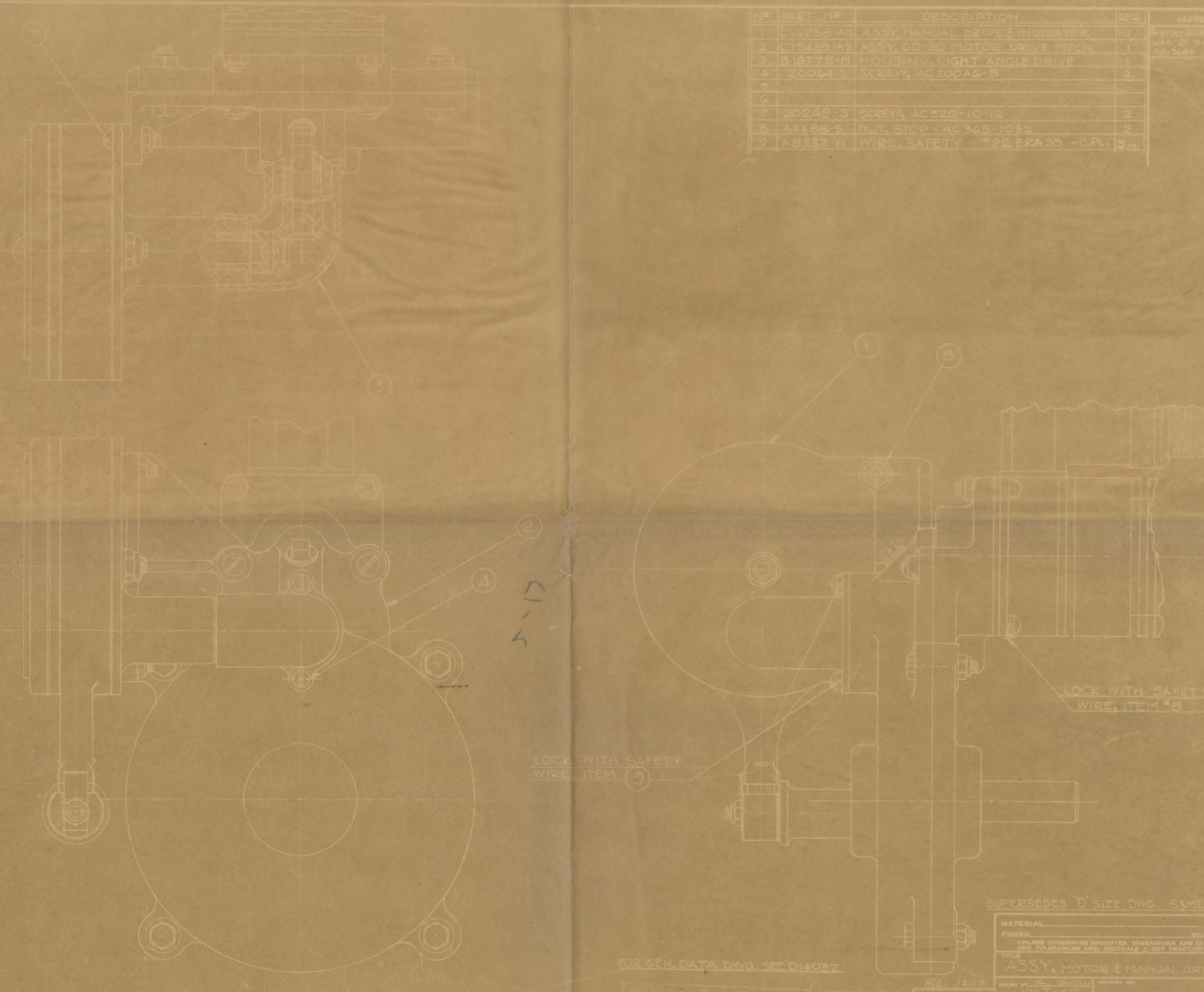
Nº	PART Nº	DESCRIPTION	REQ.
1	C16258-AS	ASSY, MANUAL DRIVE & INDICATOR	1
2	C15439-AS	ASSY, DD-20 MOTOR DRIVE MECH.	1
3	B18775-N	HOUSING, RIGHT ANGLE DRIVE	1
4	20064-S	SCREW, AC500A6-8	2
5			
6			
7	20242-S	SCREW, AC520-10-12	2
8	A4488-S	NUT, STOP - AC365-1032	2
9	A8333-W	WIRE, SAFETY - #22 BRASS - C.PL.	9 IN.

ALTERATIONS



SUPERSEDES "D" SIZE DWG. - SAME Nº

FOR GEN. DATA DWG. SEE D14032

AL. 1207

QTY.	USED ON
1	D14032

MATERIAL

FINISH SCALE FULL

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: DECIMALS ± .005 FRACTIONS ± .010

TITLE ASSY, MOTOR & MANUAL DRIVE

DATE 10-7-42

DRAWING NO. C16216-A 2

SUPERSEDES ALL PRINTS PRIOR TO 10-7-42

LEAR AVIA, INC.
PIQUA, OHIO U.S.A.

Design 2-13

End of this document

Telegram

July 20, 1943

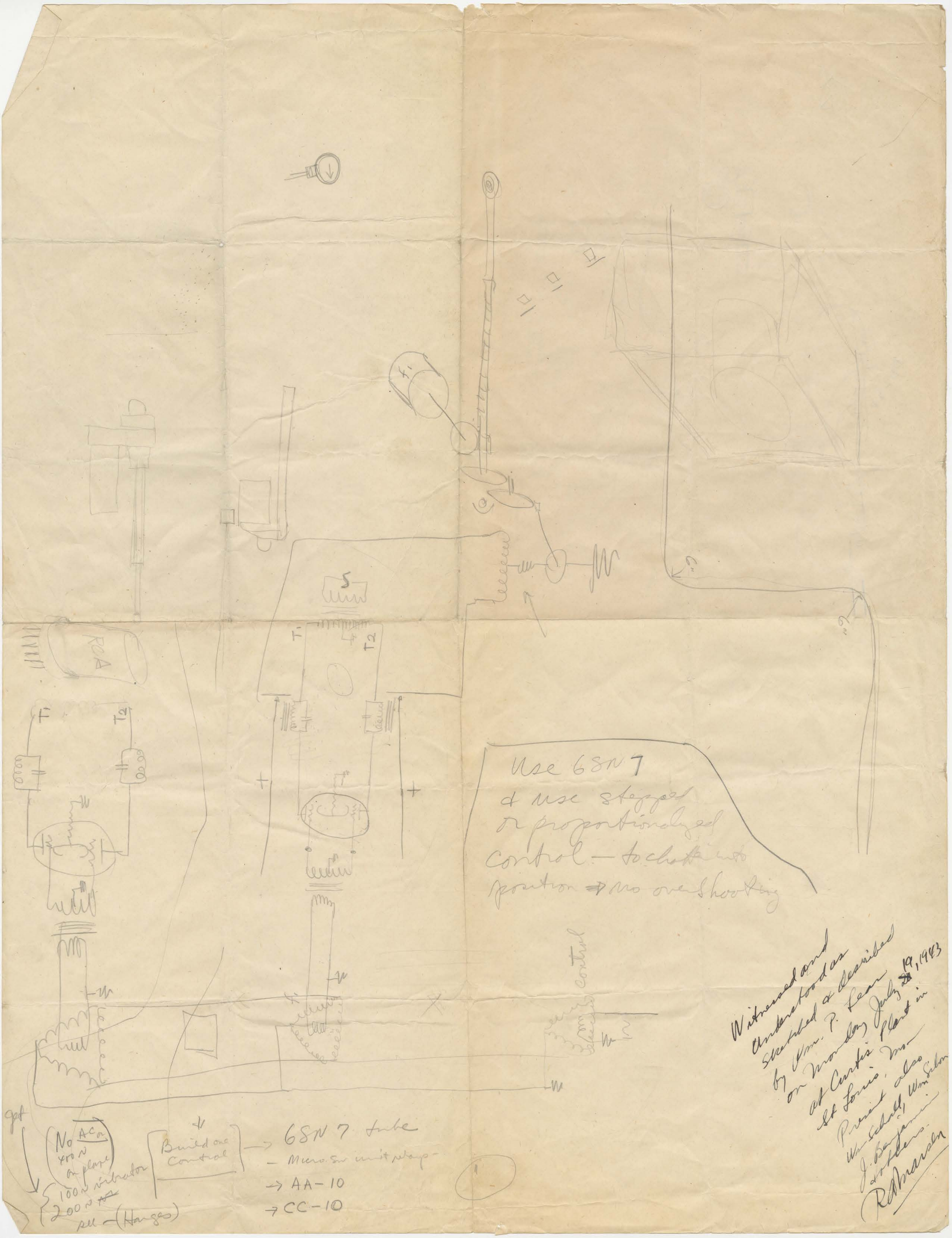
Immediately concentrate on circuit research using Selsyn references, Dual Triode, AC control voltage from vibrator and acceleration sensitive device, which can be disc generator principle similar to Sperry ADF. Disc would be on end of DC motor pinion. Acceleration sensitive circuit without moving parts would be preferable. Require one percent control of actuator's position but desire one quarter percent if possible.

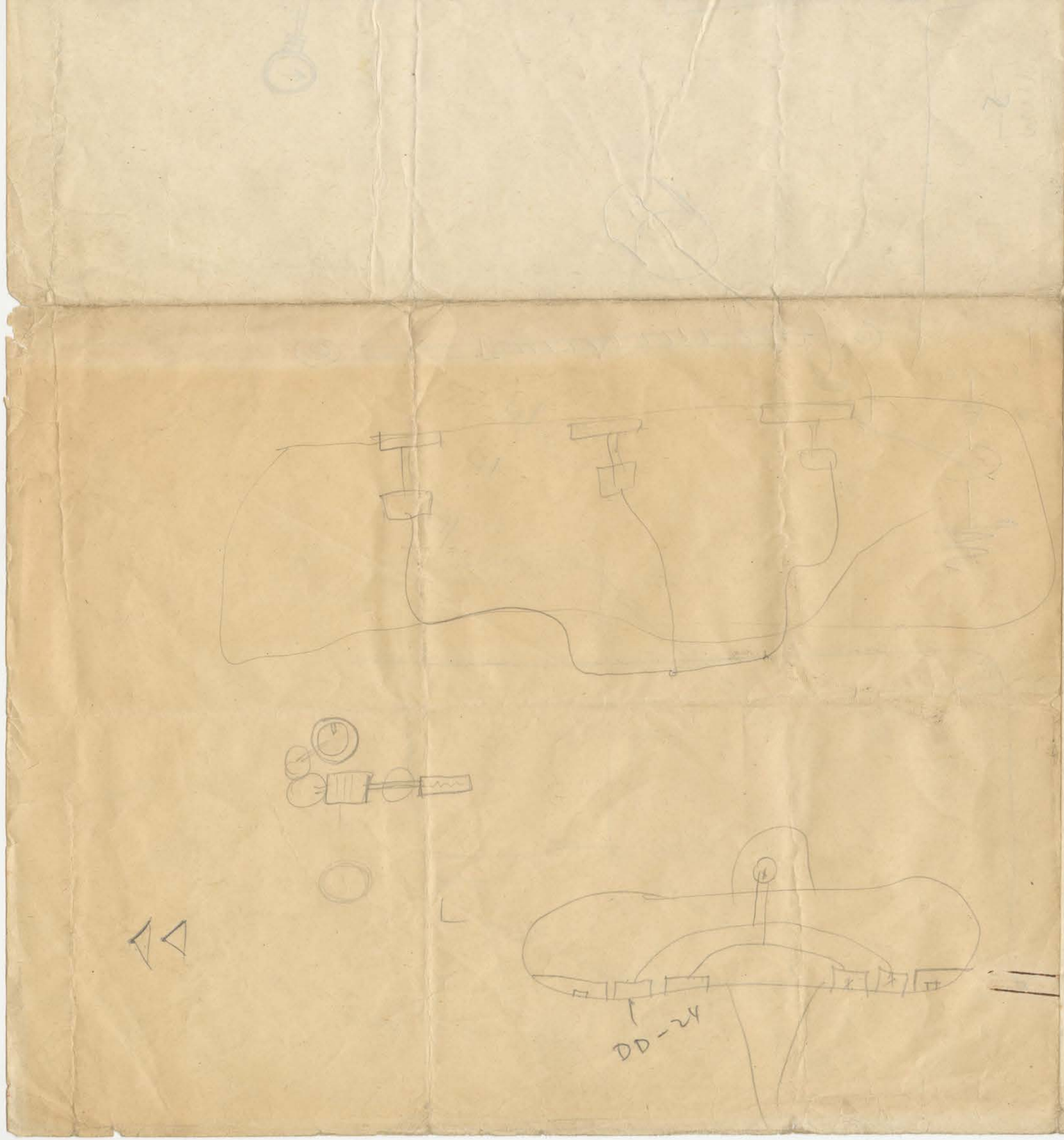
Time is the essence of this development. Please keep me posted daily.

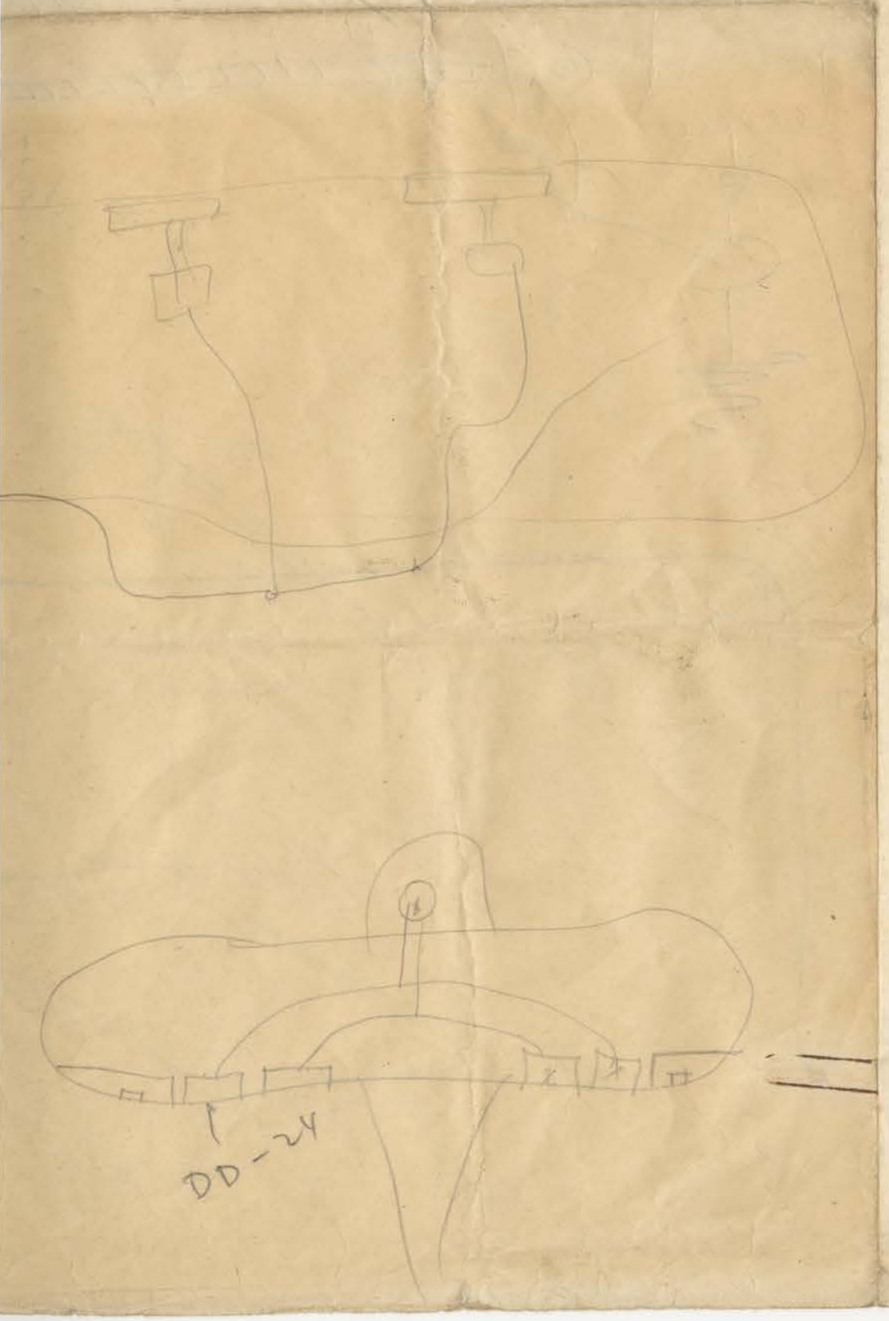
Signed

W.P. Lear

R. A. M. + D. decided not to investigate disc acceleration electrical. 7/28/43


Use 6SN7
& use stepped
or proportioned
control — to shoot into
position ⇒ no overshooting
Witnessed and
understood as
sketched & described
by Wm. P. Lear
on Monday July 19, 1943
at Curtis Plant in
St Louis, Mo.
Present also
Wm Schaldt, Wm Sidon
J. Bayonne
& others
R. Pearson
Rec A
T1
T2
S
Control
gpt
No AC on
100 ~ vibrator
200 ~ vibrator
pcl — (Hargas)
Build one
Control
6SN7 tube
— Micro. sw unit stop
→ AA-10
→ CC-10




DD-24

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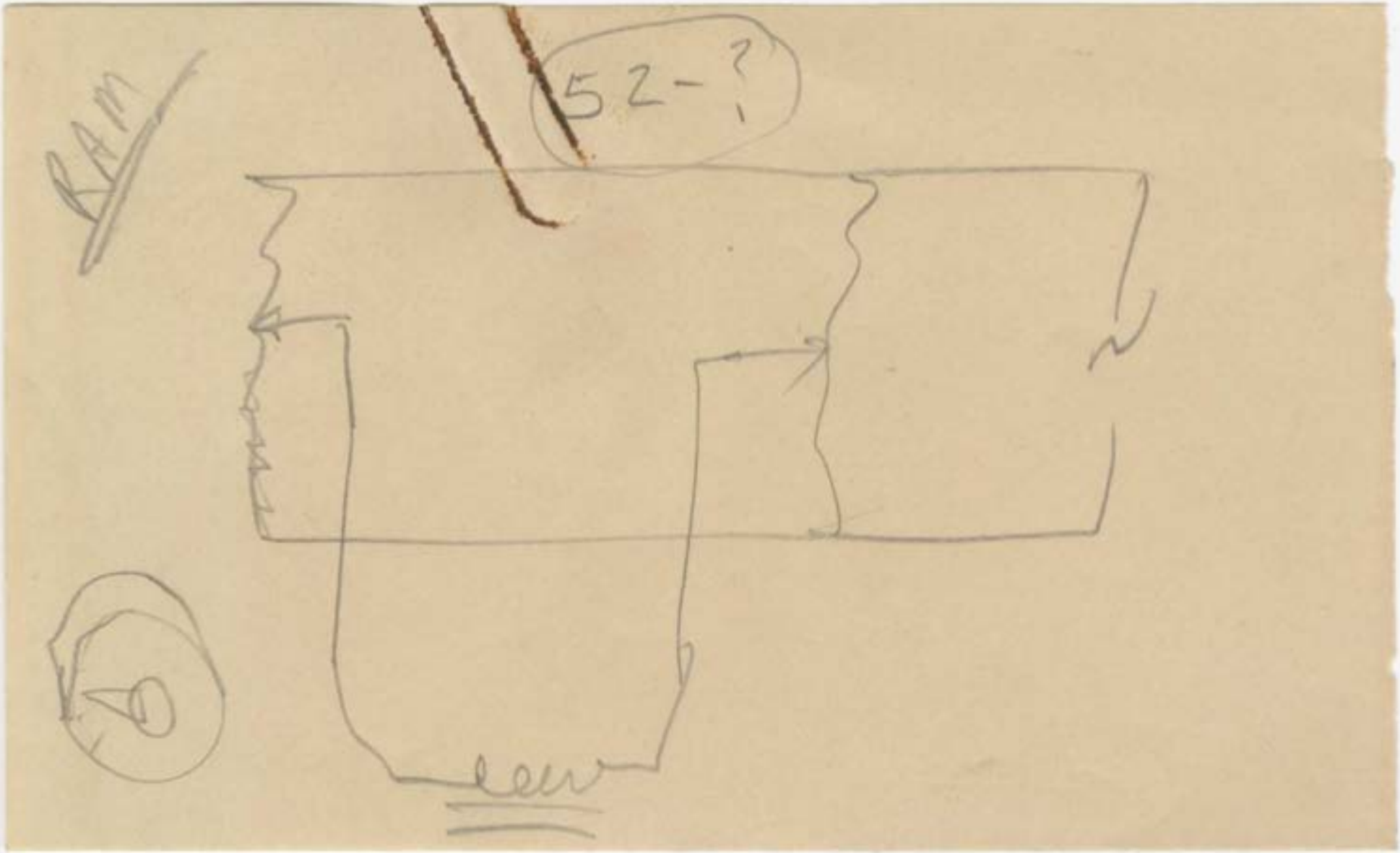
52-?

~~Sperry~~

Cd 10P

Are Selsyn + Tubes + ~~relay~~ + motors

new

See Hull

Moseley uses relays operated by tubes.

Hull no relays but uses back gear on motor in indicator + Selsyn.

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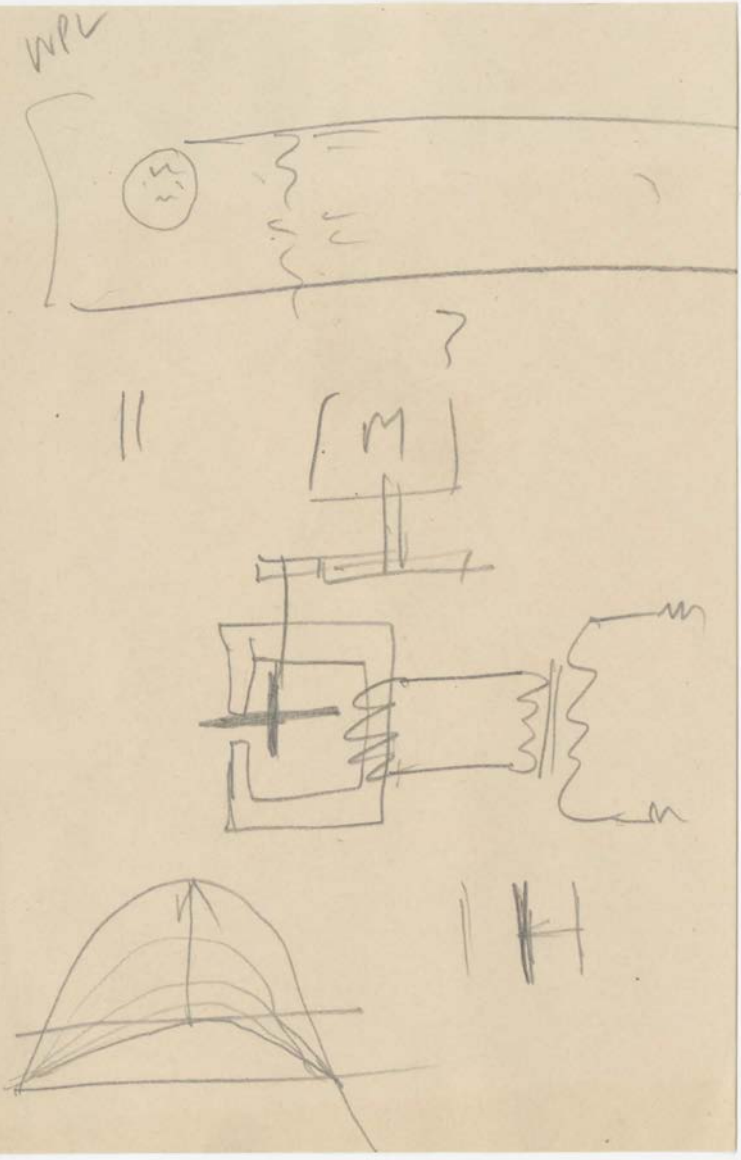
WPL
M

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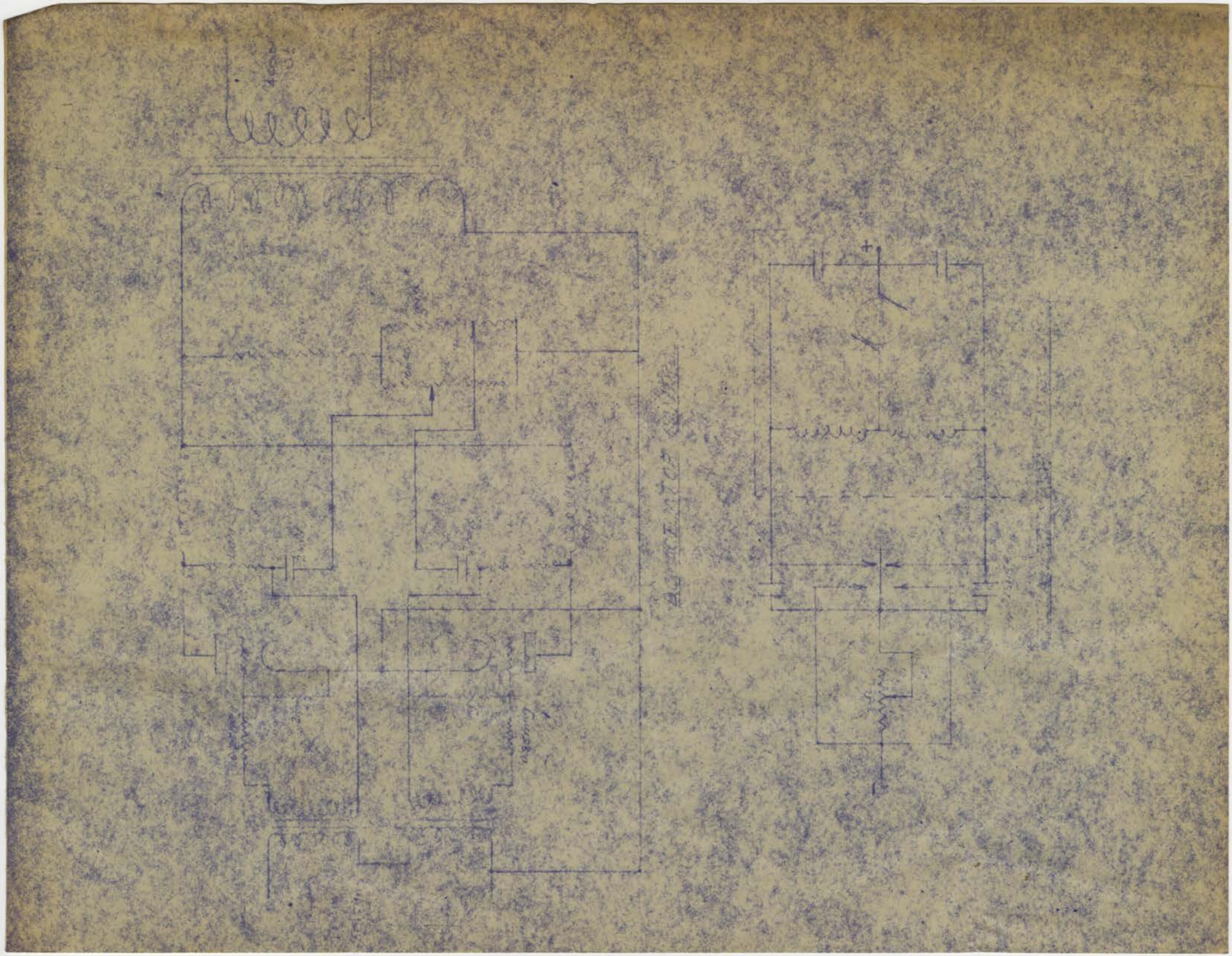

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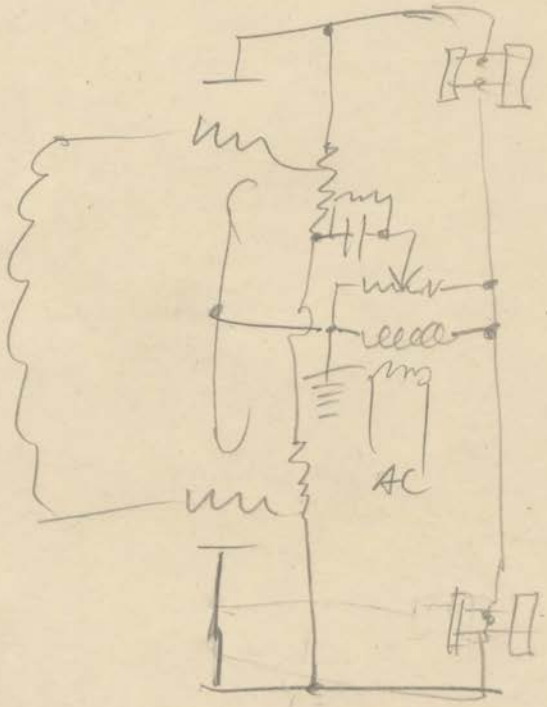
AC

Ed 101

(A) – Prop Synchronizer

(B) – Mechanical Pitch Changers

(C) – Heartron Control (1)

(D) Duplex Control

C-7 – Successive contacts relay with motor R

C-6 – Investigate polarized diff. relay

~~C-5~~ ~~develop~~ in Heartron

C-1 Antivaporator R+C in plate circuit

C-2 " R+C in grid circuit

C-2' " Common R+C for both grids

C-3 " Kickback

C-4 " Inductive kickback from motor (Roberts?)

~~C-5~~ Fund. effect of different types of "null" means of adj.

C-5 Heartron with AC Potentiometers

Roberts says he has reference code with variations of circuit on this

Electric heads sensitive Leartron

(E) and Temp Control

Priority

1 Leartron - all variations Roberts
2 Flipplex - Control Nygard
3 ATC - Sedwitz, Ira
4 Prop Synch Nils Ecklund
5 Mech geared prop Control - Ray

Or Duplex, Note "Yaw" control
re propellors

Also emergency manual override
using vibrator relay interrupter
of resistance to motor
may be Ecklund

Calien – Request N14 Eng. return

52-2 Combine with Roberts transformer
protective ideas

Electron with Governor – Care – This
seems to be new combination – ? +
"override" –

Ld – 10!

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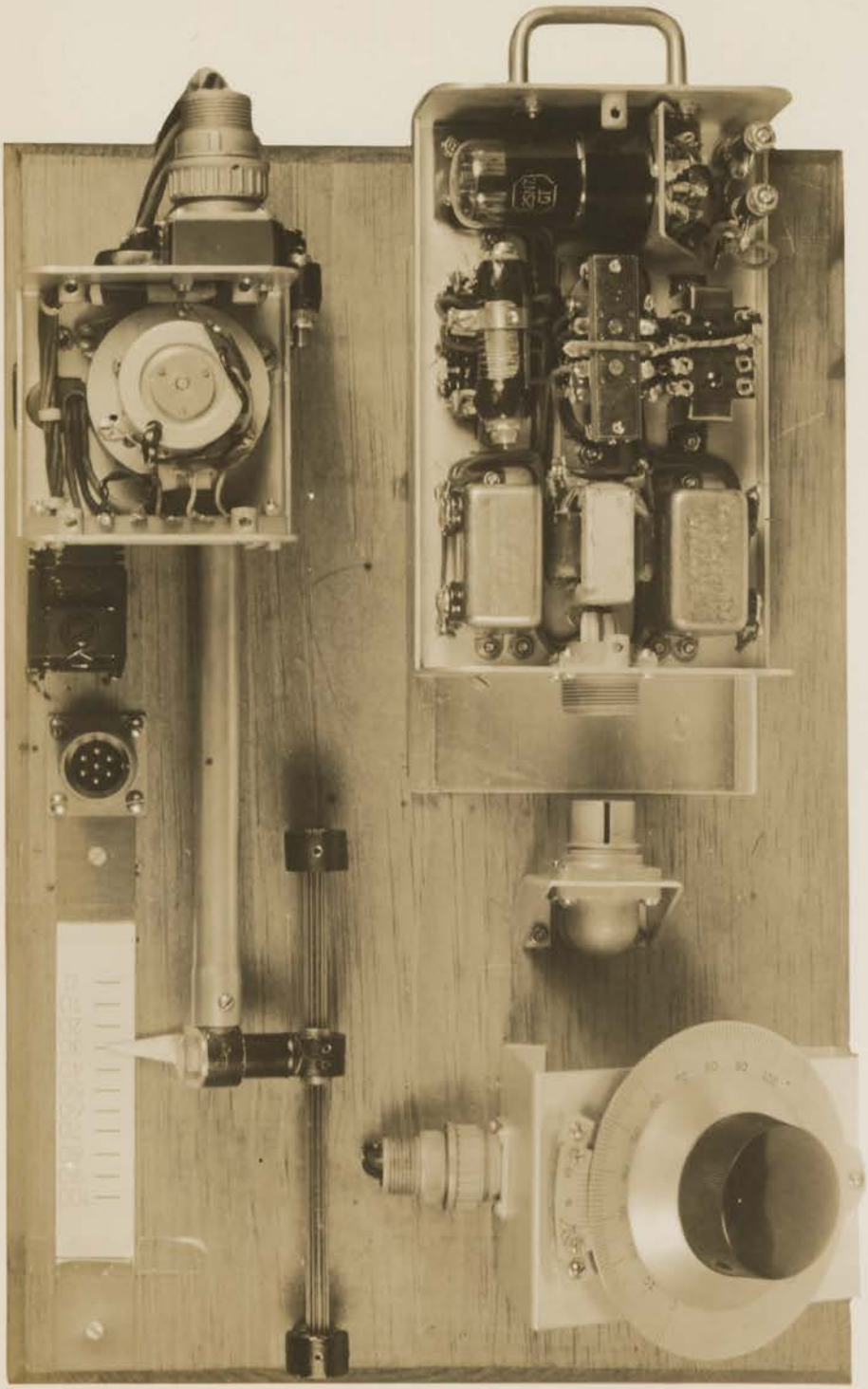

LEAR AVIA Inc.
PIQUA, OHIO

TITLE

DESCRIPTION

SUBJECT FILE

NEG. No. 5678

2000-06-20

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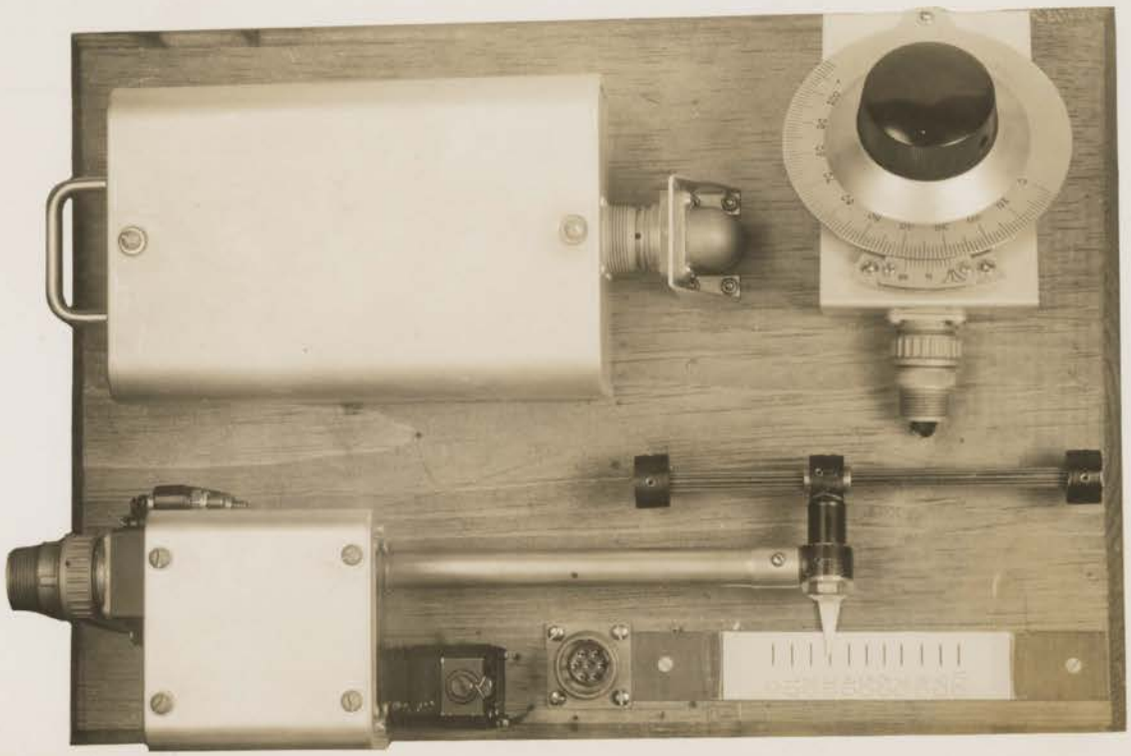

LEAR AVIA Inc.
PIQUA, OHIO

TITLE

DESCRIPTION

SUBJECT FILE

NEG. No. 5679

2000 06 20

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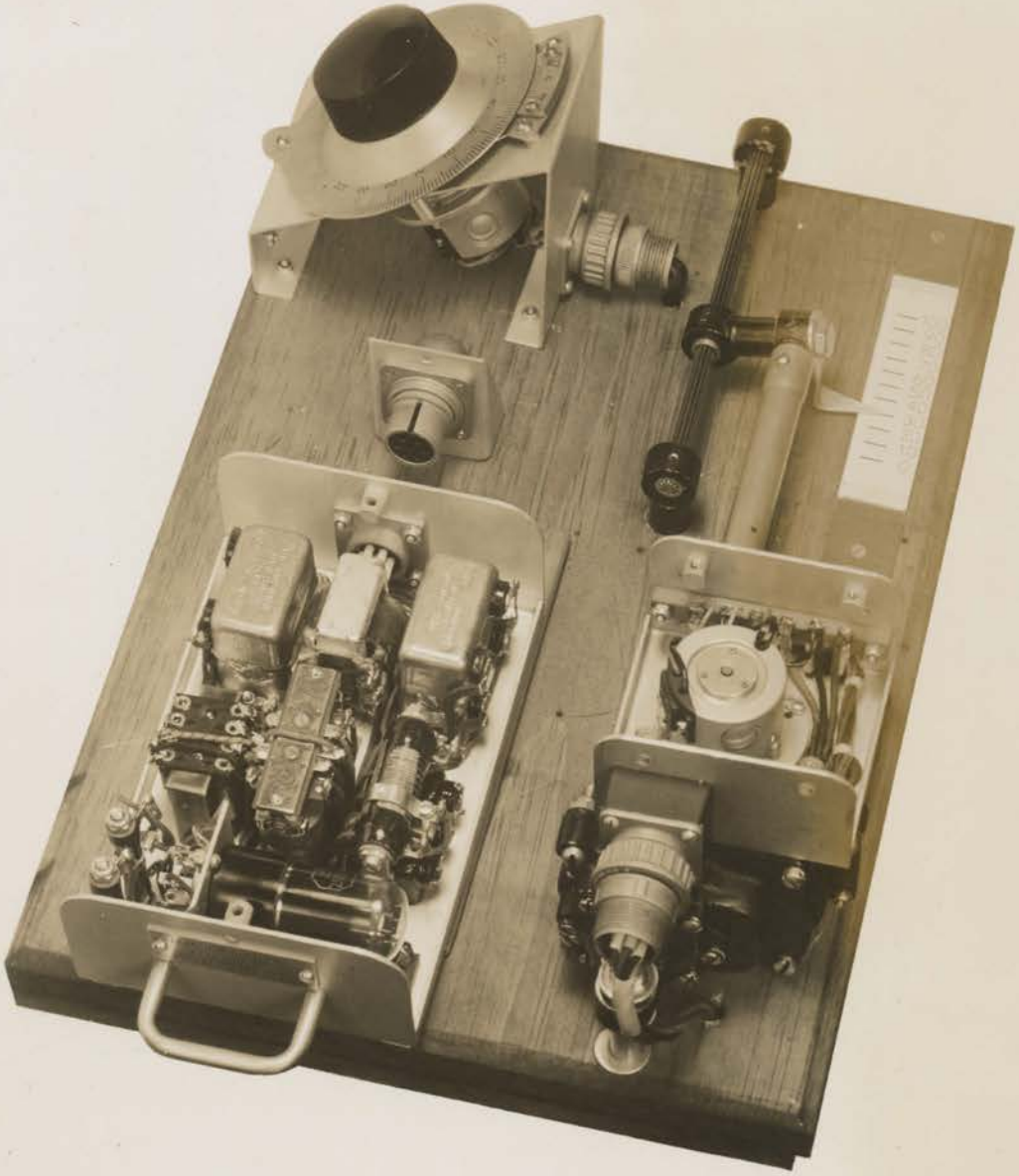

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Leartron Cases (N.Y. Lab)

Case No.	Inventor	Subject, inc. Prints, Sketches, etc.
52-2	Nygaard	R-C in plate circuit - Relay kick back - Differential Relay in combination (C-1, C-4, C-7)
52-3	Roberto	R-C in grid circuit, including individual + common R-C's (C-2, C-3)
52-4	Nygaard	System including "successive contacts" relay (C-8)
52-5	Roberto	C-5 - Inductive "kick back" = cont. of 52-3
52-6	Nygaard	System Duplex with sinusoidal friction spring "Fastop"
52-7	"	Duplex Control per se
52-8	"	" " in system
80-11	Nygaard et al.	"Fastop" with sinusoidal friction spring
77-	" —	Differential relay construction - per se
77-	" —	Successive contacts relay construction - per se
45-1	Lear	Broad case on ATC
45-2	Sedwitz	Specific " " "

52-2 Nygaard C-1, 4, 7

52-3 Roberts C-2, 3

52-4 Nygaard C-8

52-5 " Angle Lateral System

52-6 " Lumbar C. pos.

52-7 Roberts C-5 - cont. of 52-3

Leartron Cases

Case No.	Inventor	Subject and Prints, Sketches etc.
52-2	Roberts	(B) C-2, C-3, ~~[illegible]~~
52-3	Nygaard	(A) C-1, C-4, C-7.
52-4	"	(C) C-8
52-5	Warren?	Duplex control system ~~[illegible]~~ 2 cases = Nygaard System & also as clutch — maybe Count or sole
80-11	Nygaard + Gilchrist	"Faston" clutch with sinusoidal friction spring
52-	Roberts	C-5 = Roberts - cont of 52-2
52-1	Leart	Broad case on "Leartron"
45-1	"	" " " ATC
45-2	Sedwitz	Specific " " "

Iconitron

C-1 Anticipation R-C in plate circuit
C-2 Inventor — Nyggaard

C-2 Anticipation R-C in grid circuit.
Inventor Roberts? 9-11-43

C-3 Anticipation - Common R-C both grids
Inventor Roberts? 10-1-43

C-4 Anticipation — Relay Kick back.
Inventor ~~Roberts~~? 10-21
11-10
→ Nyggaard (3) (4) 11-17

C-5 Anticipation - Inductive Kick Back from motor
Inventor - Roberts 11-30
12-13
~~Nyggaard (2) (4)~~

C-6 Iconitron with A.C. potentiometer
Inventor
(Probably anticipated)

C-7 Differential Relay - Parse & the Iconitron
Inventor - Nyggaard

C-8 Successive contacts Type relay with R in motor circuit
Inventor - Nyggard?

Duplex control

Duplex :–
  Y air Control
  Over Ride
  – Vibratory relay interrupter

ATC   Ld 103

Broad – W P Lear
  Specific ~~Ira~~ Sedwitz

Prop. Synch.

Wib Echlund

Mech. Geared Prop Control

Ray

Cont. Magnetic Recording

Note V101

Roberts
- 12-13-43 - RC common grid
- 11-10-43 - " " "
- 11-17-43 - " " "
- 11-30-43 - " " "
- 9-11-43 - RC in each grid

Koppaard
- 8-10-43 - RC both plate + grid
- 10-21-43 - RC grids
- 10-1-43 - " "

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LEARTRON CONTROL SYSTEM L-6-101

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