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RADIO HUT COMMAND SYSTEM UPDATING

December 1963

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1. INTRODUCTION

These instructions are for the purpose of installation and operation of the latest Field Site Command System. The current requirement at the Command Stations is the addition of a Digital Command Tone Generator (DCTG) which will be used together with the existing MTU in order to provide both a revised command operation and the transmitter switching features of the MTU. This is made possible by making minor modifications to the MTU which will allow the digital commands to pass through the MTU and at the same time retain the transmitter remote switching features of the MTU.

2. GENERAL DESCRIPTION (DCTG)

The Digital Command Tone Generator performs two functions:

a. The generation and timed sequencing of selected tone pairs which are used to modulate the transmitter.

b. Keying the transmitter for a period long enough to send one command.

The DCTG is a complete modulation unit containing its own power supply and could be used to modulate one transmitter. It does not contain the desirable remote station control features of the MTU and is therefore connected through and used with the MTU in this particular application.

The three modes of operation provided are Automatic, Continuous and Composite. For an explanation of each mode see paragraph 4.4.

3. OPERATING INSTRUCTIONS (DCTG)

Insure that all cards and tuning forks are properly installed and that stack plugs and the power plug are connected. Turn on power switch.

3.1 AUTOMATIC OPERATION (AUTO.)

a. Set function switch to Auto.

b. Set up command functions desired on the tone pair selector switches on the front panel. The following table gives the tones available at the various positions of the tone selector switches. Any tone switch set to a missing position in the table will Automatically select +7 volts for that position.

TABLE 3-1

DCTG, TONE LOCATIONS

Switch	Tones

c. Insure that the address commands are sequential and in the event that all ten commands are not desired insure that the unused pairs are set to the +7 volt position so that an unwanted command will not be sent.

d. Depress execute switch until standby indicator goes out and release. The DCTG will cycle and stop automatically.

3.2 CONTINUOUS CHOPPED (CONT.) OPERATION

a. Set functions switch to Cont.

b. Set up command function desired on the tone pair selector switches. (See 3.1 b)

c. Set SCR selector switch to pick the tone pair desired. (The indicator light will show which pair has been selected.)

d. Depress the execute switch and hold as long as transmission is desired.

e. Before selecting another tone pair release the execute switch to prevent Transmission of erroneous commands.

f. Repeat steps b, c, d, e as required.

3.3 COMPOSITE (COMP.) OPERATION

a. Set function switch to Comp.

b. Select the tone pair desired on <u>tone selector switch pair 1 only.</u>

c. Depress Execute and hold as long as transmission is desired.

d. Release Execute switch before selecting another tone on <u>tone selector switch pair 1 only</u>.

e. Repeat b, c, d as required.

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4. THEORY OF OPERATION (DCTG)

The DCTG consists of three basic parts and can best be explained with a brief description of each.

4.1 TIMING AND SWITCHING

The timing circuitry consists of one astable (clock) and two bistable multivibrators (ff1, ff2) connected serially whose outputs are diode gated to provide switching gates. The output of the second bistable (ff2) is differentiated to provide the timing pulse to the SCR ring counter.

4.2 SCR RING COUNTER

The ring counter remains in standby until the execute switch is depressed in Auto. mode at which time a timing pulse from ff2 turns on SCR2. SCR 2 turning on turns off SCR 1. This process continues until the ring counter has counted through 10. The 11th count puts it again in standby.

As each SCR fires it turns on a pair of gates whose inputs are selected by their respective tone pair selector switches.

The pairs of gates controlled by the SCR's are tied to separate common lines. These two common lines are the inputs to the chopping switches which are controlled by the switching gates. These chopping switches have a common output which is tied through a series switch to the output amplifier. The series switch is controlled by the execute switch and the 11th SCR depending on the mode of operation.

4.3 TUNING FORKS AND TONE PAIR SELECTOR SWITCHES

The tuning forks are biased up to a DC reference level and are fed to the tone pair selector switches through an emitter follower. The switches are bussed together so that the same tone is in the same relative switch position. The tones selected are present at the emitter of the gates controlled by the SCR's which are gated on by the SCR as explained in paragraph 4.2.

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4.4 SUMMARY

Basically, the depression of the execute switch passes a timing pulse to the gate of the first SCR to start the ring counter. The SCR firing enables the tone pair gates which pass the audio tones to the common lines, which feed the chopping switches. The chopping switches open for 25 ms each, one at a time to provide a tone burst of 50 ms duration, 25 ms of each frequency. This burst is delayed 100 ms as determined by the diode gating and chopper switching circuitry. The output of the chopping switches is clamped to a regulated voltage except during tone burst time. This clamp is removed by the same gate that determines the chopping. This output is then fed through the series switch explained in 4.2 to the output amplifier, an emitter follower.

A switched ground for transmitter keying is provided in Auto. mode by firing a trigistor when the standby SCR indicator extinguishes and turning off the trigistor when it again fires. In Cont. or Comp. mode the ground for transmitter keying is provided by the execute switch and in these modes the execute switch must be depressed as long as an output is desired.

"Auto." mode is the desired mode of operation and the one most likely to be used since it provides automatic sequential commands and minimal transmission time.

"Cont." mode can be used on previously launched payloads. It provides a continuously chopped pair of tones as long as the Execute switch is depressed.

"Comp." mode is an emergency usage mode only and should not normally be used as the signal level at the payload if it is 3 db less than that in the other modes for the same power transmitted on the ground. Also, there is no adjustment of modulation level in Comp. and the modulation on the transmitter must be readjusted if 100% modulation is desired.

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5. INSTALLATION AND TEST PROCEDURE

a. The DCTG is to be installed in the Channel A position immediately above the operating MTU. Two cables are supplied to interconnect between the DCTG and the MTU. The Output and PTT jacks on the back panel of the DCTG connect with J307 Tone In and J308 PTT which have been added to the back panel of the MTU. (See Figure 6-2)

b. Turn on Power switch.

c. Put Test Operate switch to Test.

d. Set Function switch to Auto.

e. Press Execute toggle down and release.

f. The standby light should go out and the indicator lights should light and go out sequentially from 1-10 and the standby light comes back on when 10 goes out.

g. Connect an oscilloscope to the Test jack and set the Tone selector switches to any position but +7 volts. Use an oscilloscope sweep speed of 10 ms per division and external Sync from the Sync jack on the back panel of the DCTG. Depress Execute switch and observe that the time lag from Execute to the first Tone burst is 100 ms approximately.

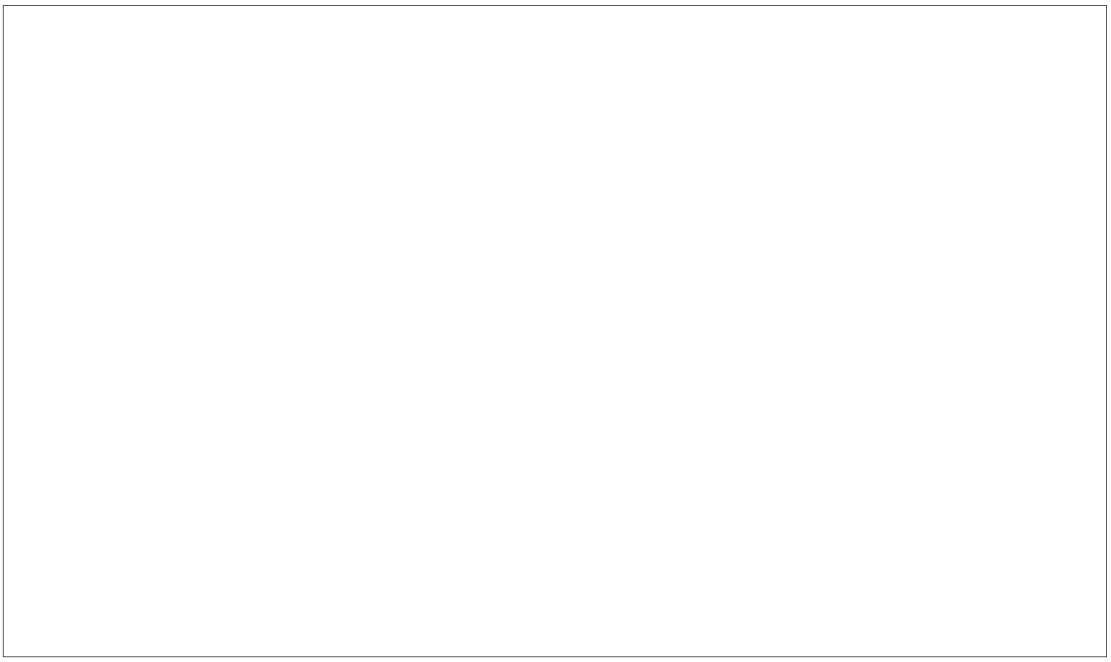
h. Set Function switch to Cont. and the oscilloscope sweep speed to 5 ms per division. Select one tone pair by means of the SCR Selector Switch. Depress the Execute switch and adjust the two potentiometers on card #7 until the Tone bursts are 50 ms in duration -25 ms of each tone.

i. Set all tone switches to the +7 volts position. Depress Execute switch and note the DC level. Set switch 1-1 to position A and 1-2 to position B. (1-1 is the first switch upper row, 1-2 is the first switch lower row.) Depress Execute switch and adjust trimpots 1 and 3 (counting from back to front) on card #1 for the DC level noted above and a ±2 volts (4v p/p) AC signal for tone A.

Follow procedure above to set up tone B, C, D, I, J, K, L, M, and N using tone A as a reference and selecting the other tones on switch 1-2 using the following trimpot location table.

TABLE 3-2

DCTG, TRIMPOT LOCATIONS



j. Set the function switch to Comp. Set tone switch 1-1 to position +7 volts and 1-2 to position A. Connect a frequency counter to the Test jack and depress the Execute switch. The tone frequencies indicated on the counter should agree with those in Table 3-2 for all positions of tone switch 1-2.

k. With the Mode switch set to Comp., depress the Execute switch and monitor the Test output on an oscilloscope as the tone switches 1-1 and 1-2 are changed through all positions. Good sine waves should be observed for all positions indicated in Table 3-1. If differing tones are selected on the two switches, a beat note pattern will be observed.

1. Set the Mode switch to Cont. Set SCR Selector switch to Tone pair one. Set Tone Switches 1-1 and 1-2 to position A. Set the Test-Operate switch to Operate. Depress the Execute switch and insure the output voltage is 4 volts p/p as set in 5i.

Connect the Oscilloscope to J301 TONE on the back panel of the MTU. Set the DCTG-MTU switch on the MTU (see Figure 6-2) to DCTG and adjust R353 (Figure 6-1) to obtain a modulation level of 0.11 volts p/p. The level of 0.11 volts p/p agrees with the existing normal remote line input operating level for the transmitter.

The transmitter audio-adjustments should be rechecked to insure the correct percentage modulation for both the MTU and the DCTG.

6. MTU MODIFICATIONS

6.1 GENERAL

The modifications required in the MTU are to provide:

a. Selection of either the MTU or the DCTG as the source of transmitter modulation and PTT control.

b. Set the level of modulation when using the DCTG.

6.2 DETAIL

The schematic of the MTU modifications is shown in Figure 6-1. Switch S315 is installed below the existing antenna switch and between the output meter and the transmit switch. The common terminals should be mounted UP.

R353 is mounted to the right of the transmit switch.

J307 Tone In is mounted on the back panel just to the right of SYNC jack J306.

J308 PTT jack is mounted on the back panel just to the right of J303 28v DC.

Standoff insulators are mounted as shown in Figure 6-2 on the back and right side chassis details. Mount one ground lug under one standoff insulator on the side panel.

6.3 WIRING

a. Connect the Black lead of R353 to a standoff insulator on the right side panel. Connect the White lead to the ground lug. Connect the Red lead to one N.O. terminal of S315. This is the Tone section of S315.

b. Remove the wire connecting C308 to terminal 1 of T301. Connect C308 to the N.C. terminal of the Tone section of S315. Connect a wire from the common terminal of the Tone section of S315 to terminal 1 of T301.

c. Lift the wire at the Collector stud of Q316 and connect it to the Common terminal of the PTT section of S315. Connect a wire from the N.O. terminal of the PTT section of S315 to J308 PTT on the back panel. Connect a wire from the N.C. terminal of the PTT section of S315 to the Collector stud of Q316.

d. Mount C319 between J307 and the added standoff on the back panel. From this standoff connect a wire to the standoff on the right side panel to which the Black lead is connected.

6.4 INTERCONNECTIONS - MTU TO DCTG

Two cables with BNC terminations are supplied to connect J307 and J308 of the MTU with Output and PTT on the back panel of the DCTG. The existing SYNC cable must be manually changed between the MTU and the DCTG depending on which time circuits are being observed.

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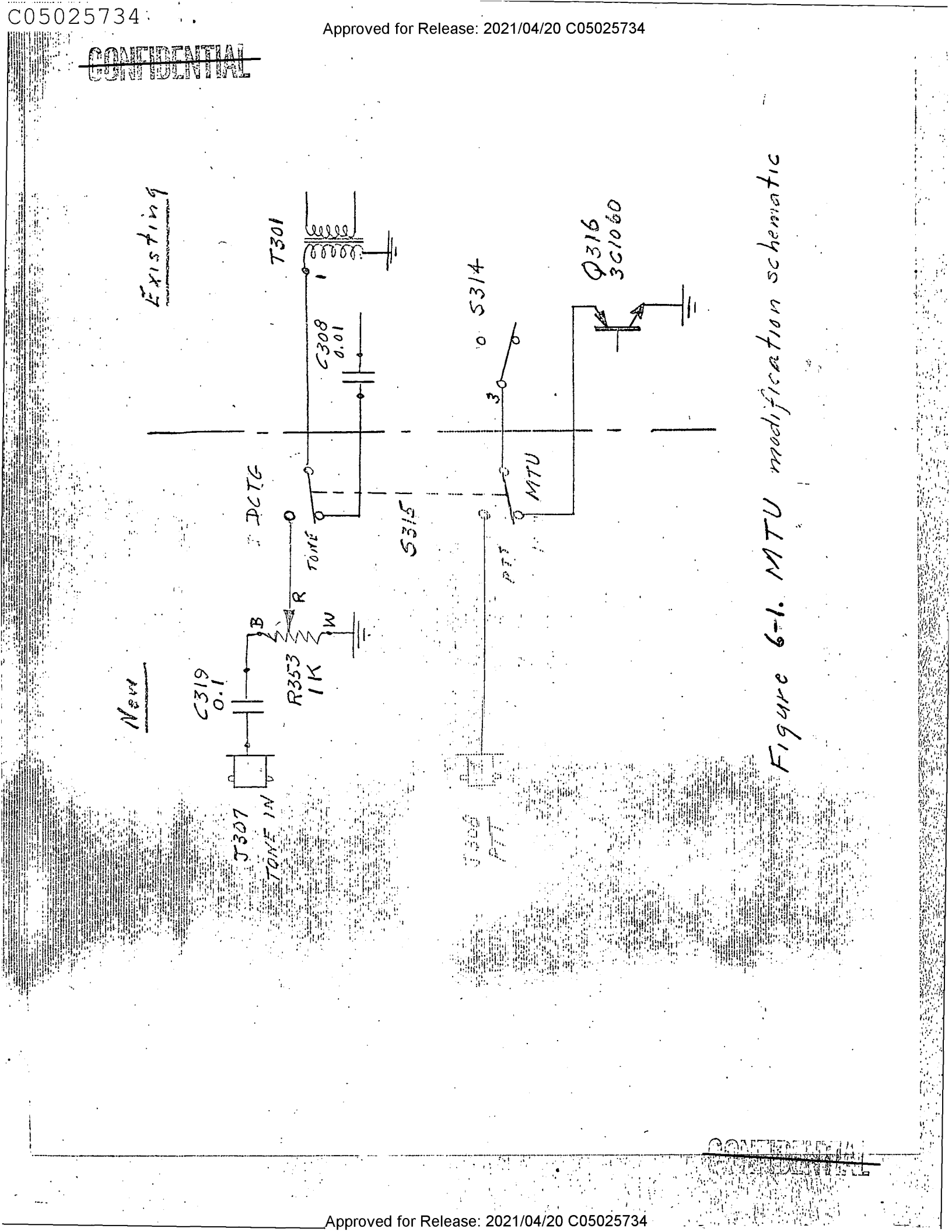

Figure 6-1. MTU modification schematic

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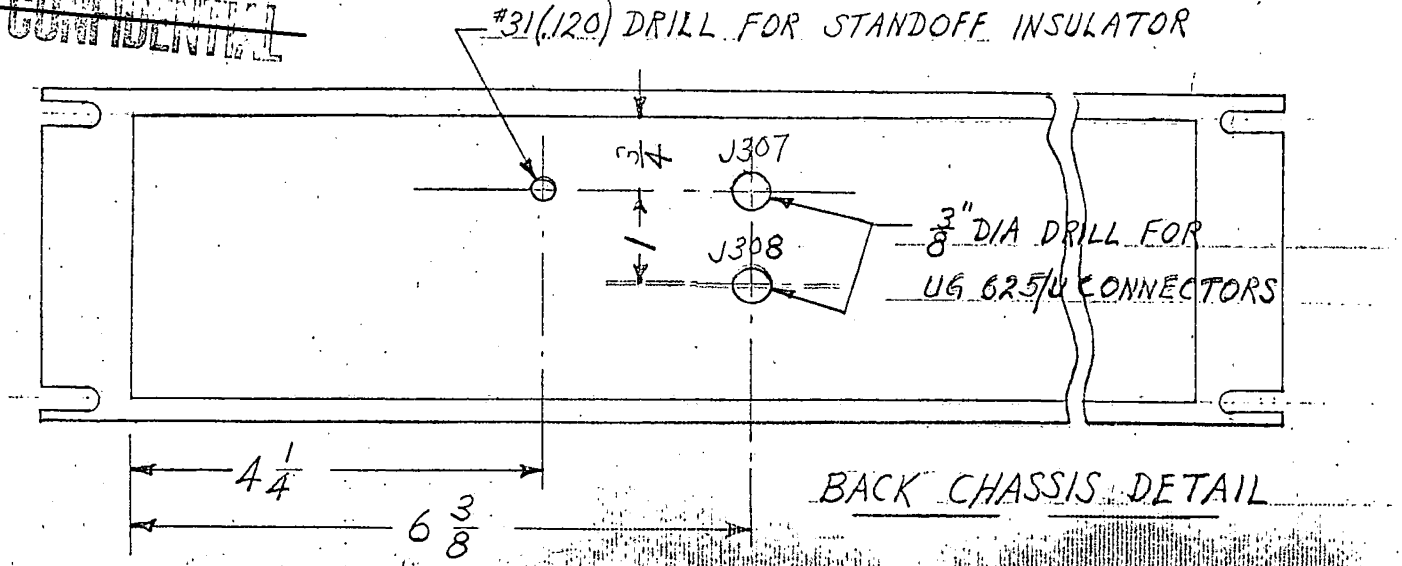
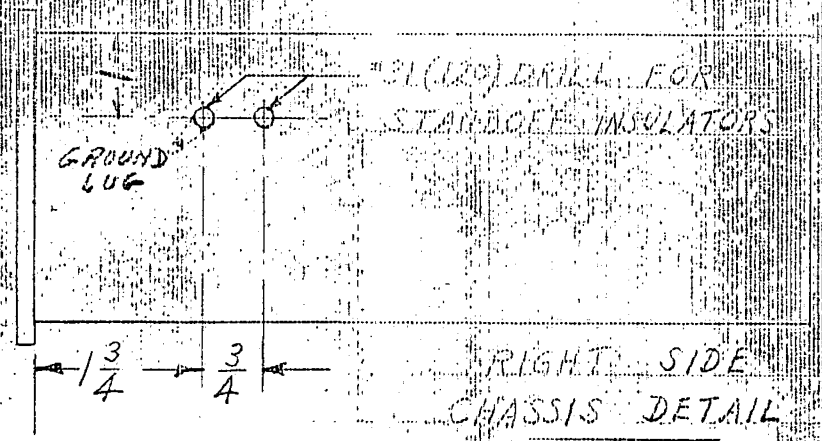
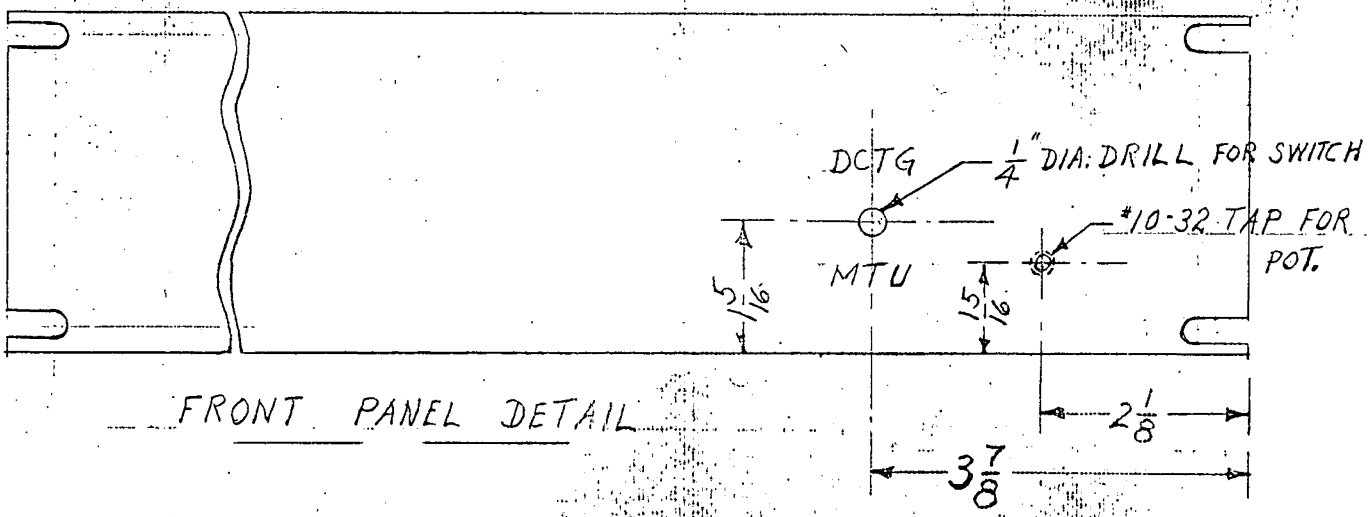


BACK CHASSIS DETAIL



RIGHT SIDE
CHASSIS DETAIL



FRONT PANEL DETAIL

Figure 6-2. Details

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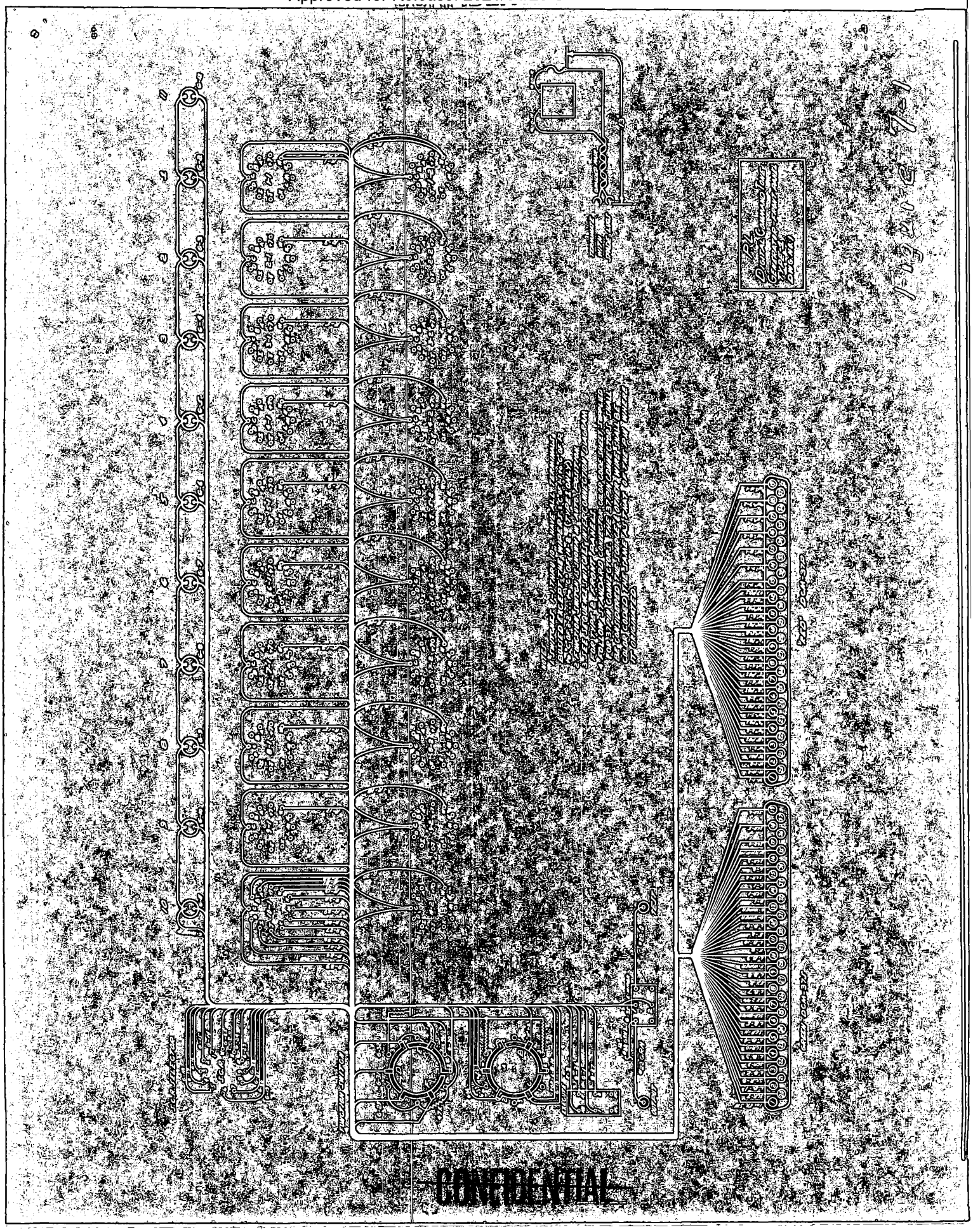
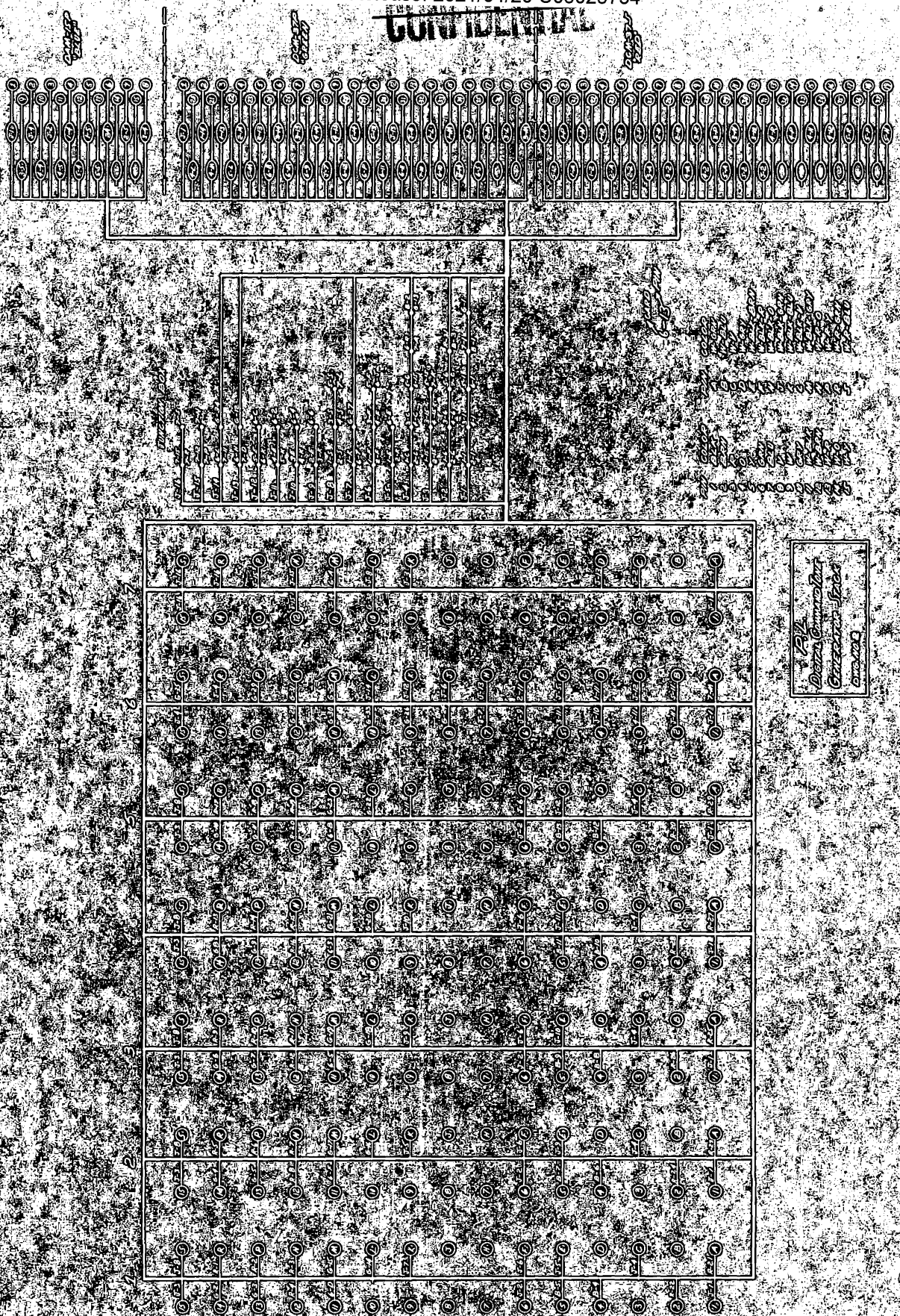


Figure 7-2



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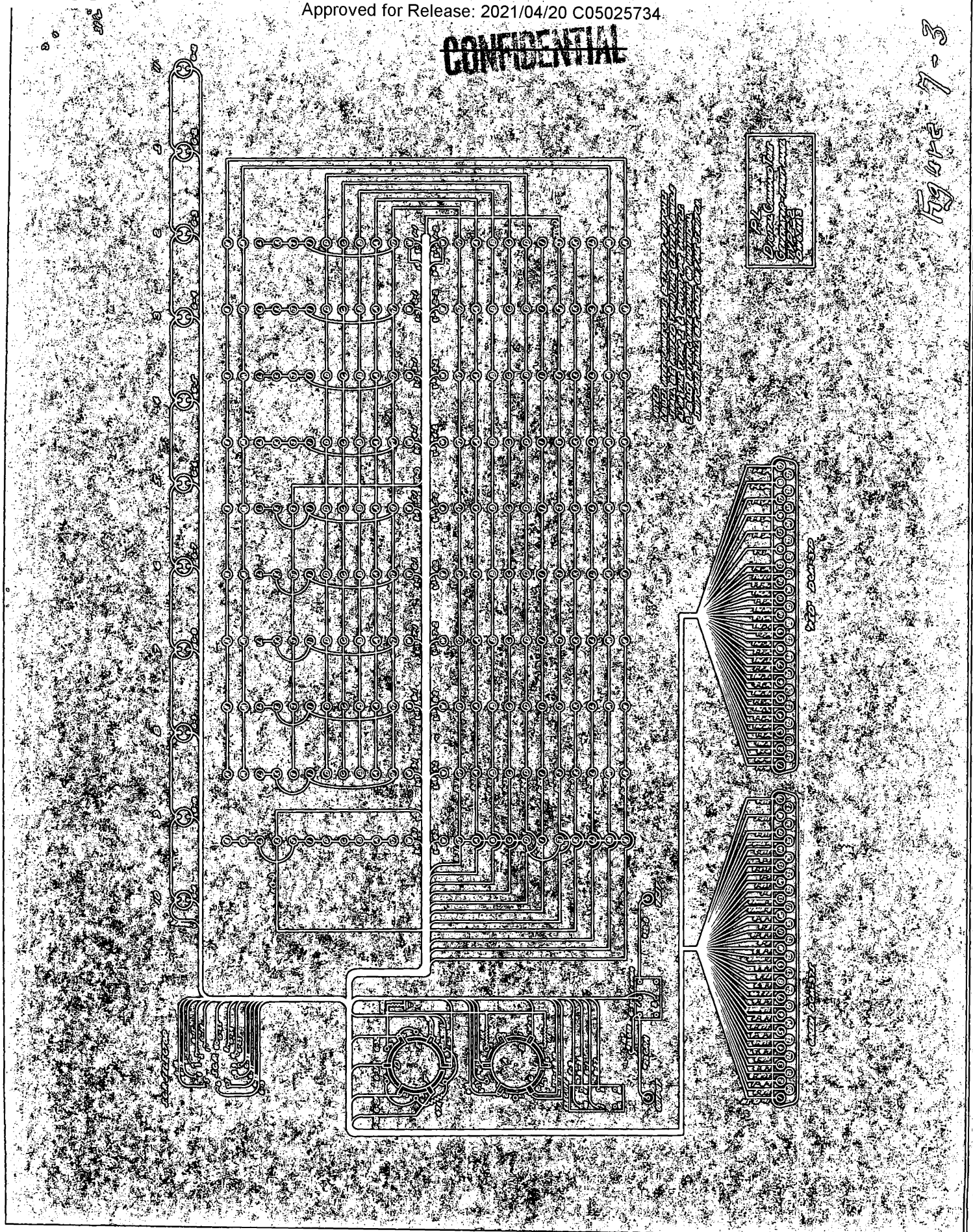

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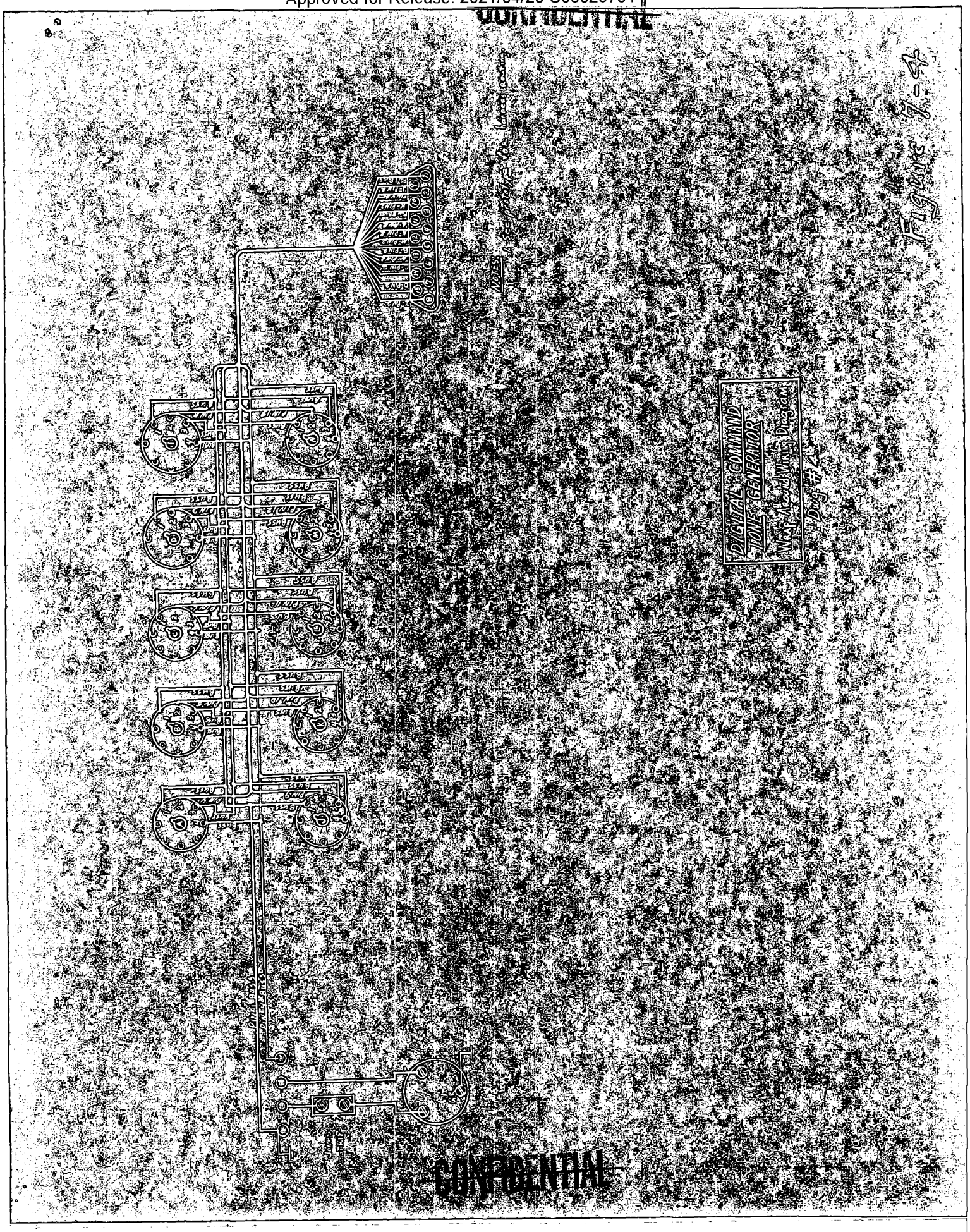

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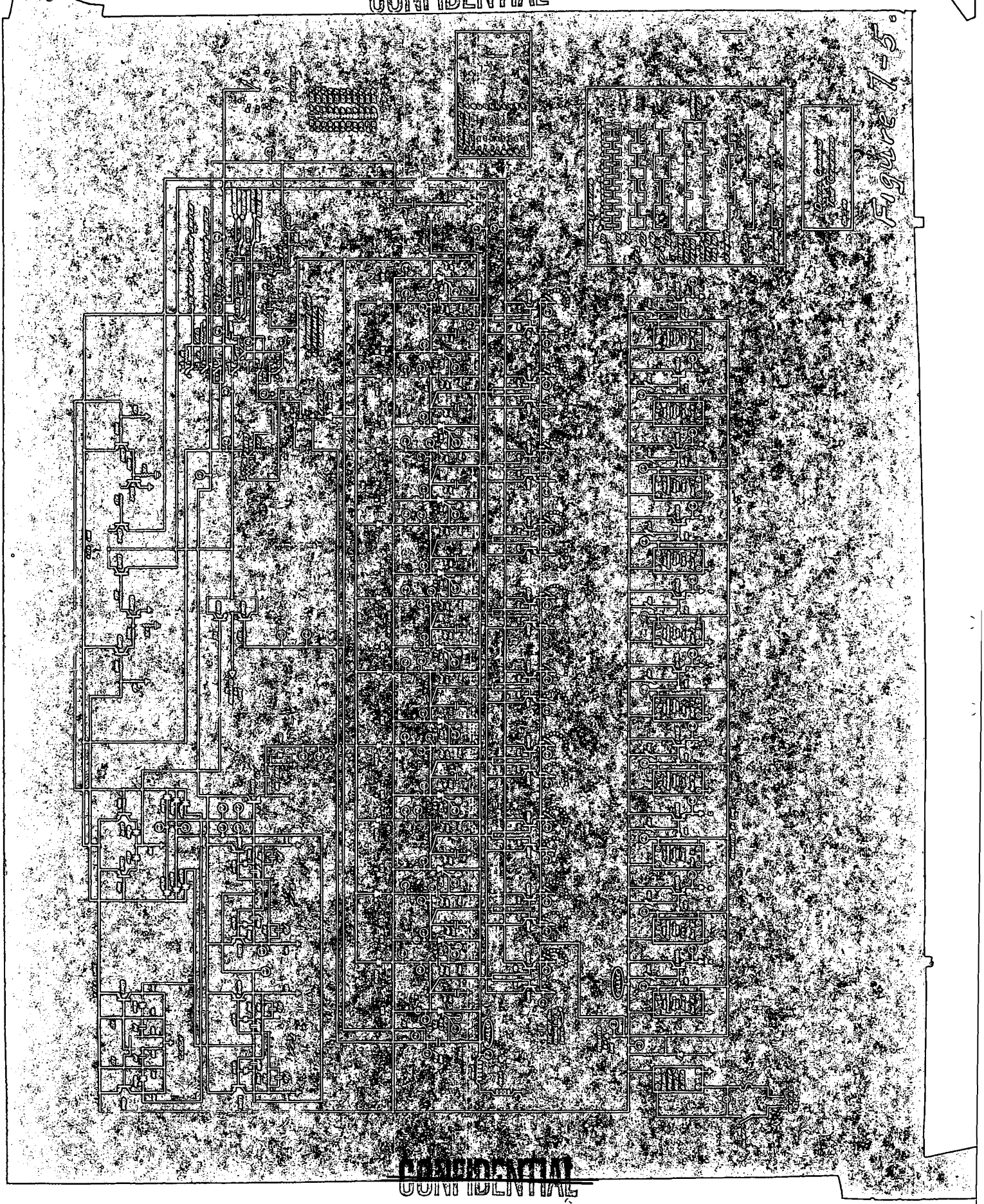

Figure 7-5.

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