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DC TECHNICAL REPORT 52-134

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EVALUATION OF INTERFERENCE BLANKER MX-1077(XA)/U

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COMMUNICATION AND NAVIGATION LABORATORY

JUNE 1952

WRIGHT AIR DEVELOPMENT CENTER

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EVALUATION OF INTERFERENCE BLANKER MX-1077(XA)/U

Raymond R. Holberger
Herbert M. Bartman

Communication and Navigation Laboratory

June 1952

RDO NO. R-112-28

Wright Air Development Center
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio

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McGregor & Werner, Inc., Wakefield, Mass.
Sept. 11, 1952 100

FOREWORD

The USAF activity discussed in this report has been conducted by the Communication and Navigation Laboratory, Weapons Components Division, Wright Air Development Center, under RDO No. R-112-28, "Flight Research on Atmospheric Electricity and Development of Means to Reduce Precipitation Static." The tests were conducted on Interference Blanker MX-1077(XA)/U, Item No. 1, Contract No. AF 33(038)-11215. The contractor is Polarad Electronics Corporation, Brooklyn, N. Y. The Project Engineer, Mr. Howard C. Storck, was assisted by Mr. Raymond R. Holberger and Mr. Herbert M. Bartman. Cooperation was furnished by the staff of the contractor.

ABSTRACT

The testing of Interference Blanker MX-1077(XA)/U under laboratory conditions is described. Performance tests were made in the High Voltage Laboratory, Communication and Navigation Laboratory, Weapons Components Division, Wright Air Development Center. Tests were conducted under ground corona conditions, using the million-volt generator in the High Voltage Laboratory. Single sweep oscillographic photographs of blanker and blanking pulse output are shown. It was concluded that the blanker, as submitted, did not meet specification requirements and that further development work must be performed.

The security classification of the title of this report is UNCLASSIFIED.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDING GENERAL:

W. H. Congdon
for DANIEL B. WHITE
Colonel, USAF
Chief, Weapons Components Division

WILLIAM H. CONGDON
Colonel, USAF

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INTRODUCTION

The need for the development of circuitry aimed at reducing the effects of precipitation static is indicated by the fact that radio communication and navigation systems are severely limited in range and dependability by a type of interference caused by electrostatic discharges from metallic and insulating surfaces of aircraft in flight. The most frequent cause of electrostatic charging is the passage of the aircraft through precipitation such as snow, ice, sleet, or rain. Thus the operational and tactical use of the aircraft is hampered by the decreased effectiveness and frequent failure of airborne electronic equipment and the systems at a time when they are most needed. The objective of the contract was to develop practical circuitry, and blanker equipment, designed to eliminate or greatly reduce the effect of impulsive noise incident upon the antenna prior to any signal reaching the tuned circuits of the associated electronic equipment. This was to be accomplished by blanking out the noise pulses without generating further blanking or switching transients. The major difficulties to be overcome, in addition to weight and size difficulties, were those of providing for the least loss of intelligence signal per elimination of each noise pulse; preservation of the received signal strength within the circuits without undue cross modulation difficulties while maintaining broadband reception; and especially that of generating the least additional intracircuit noise, including that of switching transients.

Original blanker circuits were developed at Lightning and Transients Research Institute under Contract No. N6ori-230, Task Order No. 1, Navy Bureau of Aeronautics. On 14 March 1949 Contract No. AF 33(038)-11215 was let to Polarad Electronics Corporation, Brooklyn, N. Y., under authority of Air Force Regulation 100-16, Communication Radio Interference Reduction.

Delivery of Item No. 1, Interference Blanker MX-1077(XA)/U (Figure 1), was made by Polarad Electronics Corporation 19 May 1951, for the purpose of performance test evaluation. The body of this report contains and integrates the results of the evaluation tests.

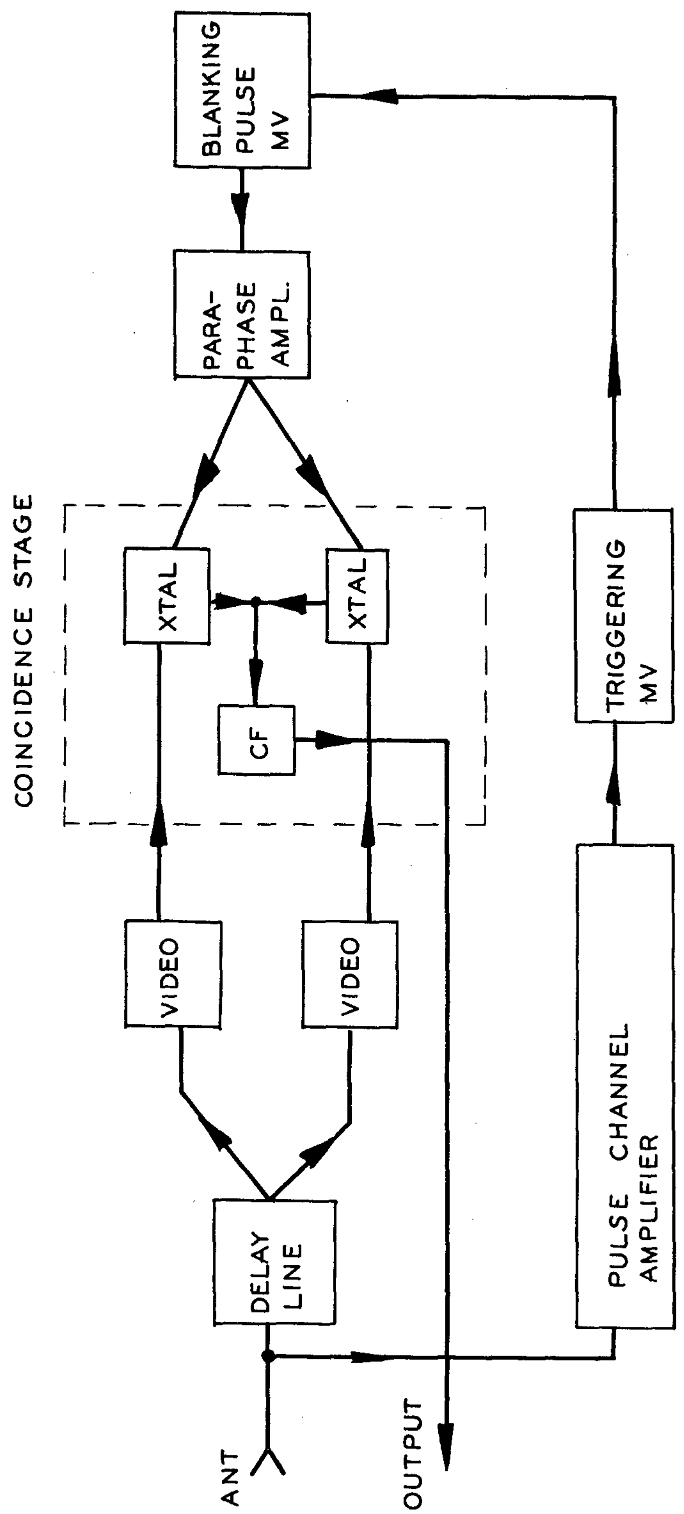


FIG. 1

BLOCK DIAGRAM OF MX 1077 (XA)/U INTERFERENCE BLANKER

SECTION I

FACTUAL DATA

The following, in abstracted form, lists data presented in attached appendices:

Video Channel: Data presented in Appendix A. The frequency response of the video channel does not meet specifications as outlined in Paragraph 3.3.6.1 of Exhibit No. MCREE-685. The transient response appears to be satisfactory according to the five megacycle bandwidth of the test oscilloscope used.

Pulse Channel: Data presented in Appendix B. The blanking pulse generator is included in the pulse channel. The most serious defect of the pulse channel is that the blanking pulse narrows considerably when the multivibrators are triggered in rapid succession. This permits a portion of the interfering pulse, when properly delayed, to extend beyond the blanking interval created by it, and is thus passed into the receiver. At full sensitivity, the blanking pulse generator begins to count down at somewhat over one million pulses per second (constant repetition rate conditions); however, the pulses narrow considerably before approaching count-down conditions. The width of the blanking pulse is not automatically extended upon arrival of following triggering pulses before the completion of the blanking pulse. The latter condition is specified in Paragraph 3.3.8.4 of Exhibit No. MCREE-685.

Coincidence Channel: Data presented in Appendix C. At conditions of constant repetition rate and optimum balance the minimum amplitude of switching transients (residuals) are of a magnitude of approximately eight millivolts. However, under the random repetition rate conditions of corona input the residuals at the output of the blanker were observed to be of magnitudes approaching 40 to 50 millivolts. It was not possible to operate the blanker with the dust cover on after approximately an hour of use because heating caused the balance conditions to drift beyond limits. Considerable overshoot was present following the blanking pulse, causing apparent blanking axis shift. Feed-through, due to the use of crystal diodes in the coincidence channel, was also detrimental to the blanking action.

Over-all Performance: Data presented in Appendix D. The over-all performance of the model blanker was checked at several frequencies from 245 kilocycles to 8 megacycles and at corona currents up to 100 microamperes. The measurement of improvement ratios in decibels appears to have little value unless combined with the measurement of minimum usable signal. The minimum usable signal ranges from 950 microvolts at 245 kilocycles and 100 microamperes of corona current to 180 microvolts at 8 megacycles for the same corona current. Measurement of noise due to residuals alone gave values up to 35 decibels above the ambient noise level. This leaves much to be desired in the light of the present state of the art.

Miscellaneous Defects: Data presented in Appendix E. The blanker, as designed, does not stand level on the shock mounts provided. Microphonic conditions in the model were such as to preclude possibility of flight tests. Cooling provisions were inadequate. Physical design of the model is such that it cannot be readily serviced.

SECTION II

CONCLUSIONS

It is concluded that Interference Blanker MX-1077(XA)/U, Item No. 1 of Contract No. AF 33(038)-11215, does not fulfill the requirements of that contract and is therefore not acceptable. Due to the deficiencies listed below and described in detail in the body of the report, the blanker would perform no useful purpose. The deficiencies apparent in the design of the blanker are:

1. That undesirable background noise is due not only to residual transients, but also to the fact that the blanking pulse generating circuits produce narrower blanking pulses when two or more closely following noise pulses are received at the antenna allowing portions of the noise pulses to reach the receiver.

2. That the blanking pulses are followed by overshoot of such amplitude and duration as to cause not only extensive variation of the blanking axis with the result that, in the majority of cases, the noise pulses over-ride the blank and appears in the output, but also cause high speed transients which are far more detrimental to reception.

3. That the defective action is attributable, to some extent, to signal and noise feed-through due to the characteristics of the crystal diode coincidence stage.

4. That the physical design of the blanker results in microphonics of such extent that the model, or copies of it, could not be flown because of that condition alone.

5. That heat generated within the blanker precludes the possibility of operating the blanker in assembled form.

The measurement of improvement ratios appears to have little value unless combined with measurement of minimum usable signal.

The experimental blanker was not tested under shock, vibration, heat, cold, humidity or other condition. The defects enumerated in this report are such as to make such tests of the present model superfluous.

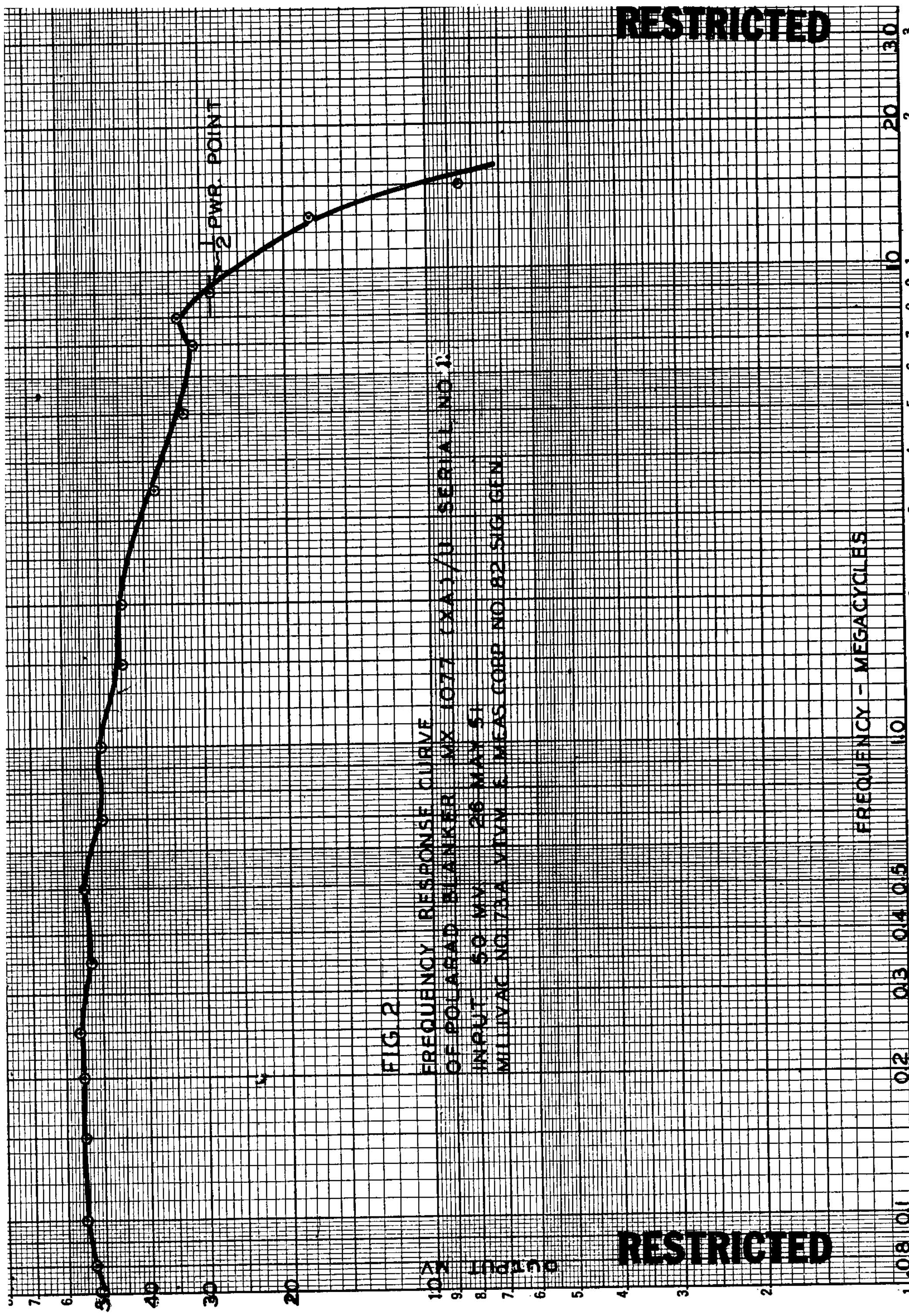
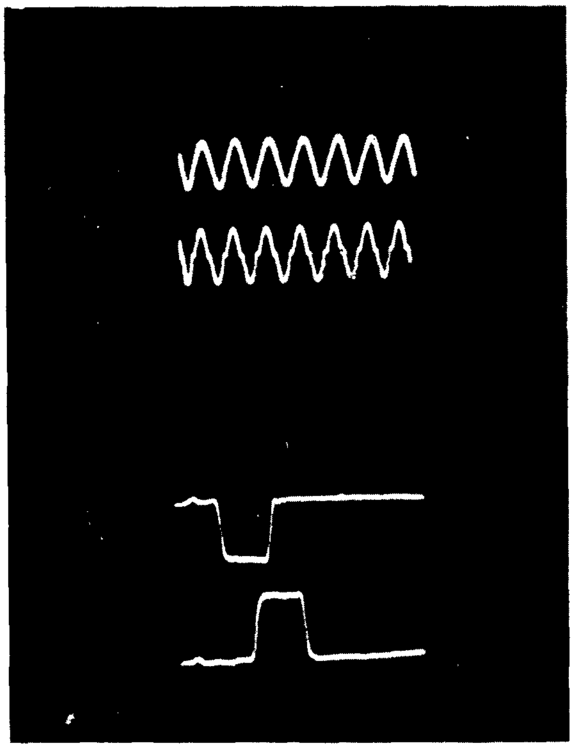


FIG. 2
FREQUENCY RESPONSE CURVE
OF POLARAD BLANKER MX 1077 (XA-1)/U SERIAL NO. 11
INPUT 50 MV. 28 MAY 51
MILLIVAC NO. 73A VTVM & MEAS. CORP. NO. 82 SIG. GEN.



A MX-1077(XA)/U output with 500 MV peak input

B MX-1077(XA)/U output with 560 MV peak input

C Pulse input to MX-1077(XA)/U

Pulse Width = 1 us
Pulse Ampl = 50 mv

D Pulse output from MX-1077(XA)/U, unblanked

FIGURE 3
SIGNAL CHANNEL INPUT AND OUTPUT

APPENDIX A

VIDEO CHANNEL

The frequency response of the Interference Blanker MX-1077(XA)/U was taken in a conventional manner by applying signal from a Measurements Corp. Model No. 82 Signal Generator and reading the output from the blanker on a Millivac No. 73A VTVM. The output was held constant and the signal input voltage was read. The magnitude of the signal used was 50 millivolts RMS at the input of the blanker. This voltage was large enough to give readable values on the instruments used, yet well below the limiting voltage. The gain of the channel was unity between 700 kilocycles and 1 megacycle. The -3db (half power) point fell at about 9 megacycles. The response curve is shown in Figure 2. The video channel is not acceptable since the bandwidth was specified to 20 megacycles or better in Paragraph 3.3.6.1 of Exhibit No. MCREE-685.

The video channel begins to slice at about 500 millivolts peak input and begins to limit at some point above 600 millivolts. This is well within the specifications which requires no limiting up to 200 millivolts peak input. Apparently, the parallel video stages are driven into a Class C operation with inputs about 500 millivolts peak. The output for a sinusoidal input of 560 millivolts peak is shown in Figure 3.

The delay line used is a distributed constant line manufactured by Millen Company, and has a delay of approximately one microsecond per 22 inches of length.

The length used in the blanker model produces a delay of about 0.6 microsecond.

The pulse distortion due to the delay line and signal channel circuitry was checked by photographing a test pulse at the input and output of the experimental model of the blanker using a DuMont 248A oscilloscope, a Tektronix type 121 wide band amplifier and a Polaroid Land camera. The bandwidth of the 248 scope is five megacycles and the bandwidth of the amplifier is 20 megacycles. The wave shapes are shown in Figure 3. The pulse width, rise and decay times are as follows:

	Base width	flat top width	Rise time	Decay time
Input pulse	1.1 us	0.7 us	0.1 us	0.2 us
Output pulse	1.1 us	0.7 us	0.1 us	0.2 us

Figure 4

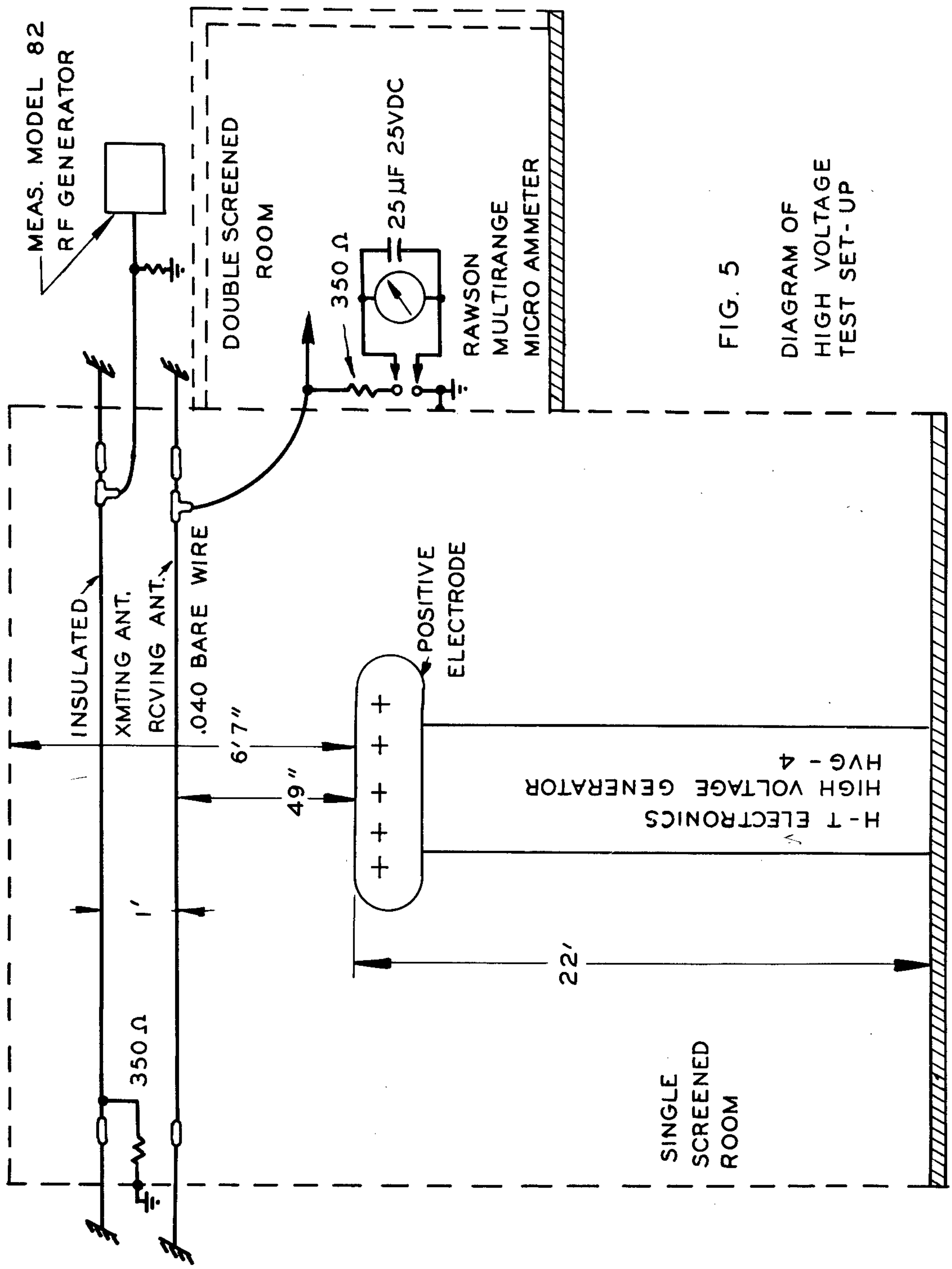
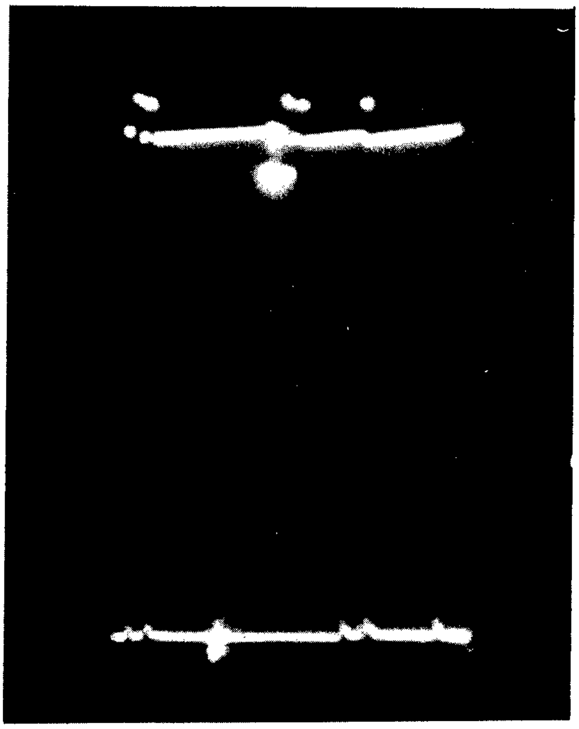
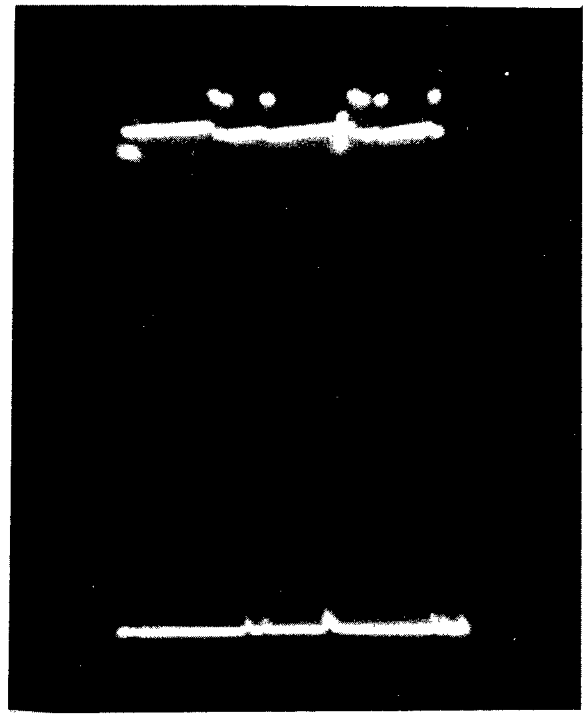


FIG. 5
DIAGRAM OF
HIGH VOLTAGE
TEST SET-UP



A



B

FIGURE 6
PHOTOGRAPHS OF CORONA PULSES AND RESULTING BLANKING PULSES

Simultaneous 125 us sweeps showing blanking pulses on the top traces and the causative corona pulses on the bottom traces.

APPENDIX B

PULSE CHANNEL

The pulse channel, which consists of a crystal stage arranged to give a unipolar output regardless of input pulse polarity, four stages of amplification, a triggering multivibrator and a blanking multivibrator, was tested on both continuous repetition rate and random pulses.

The random pulse source was furnished by corona drawn from a bare wire antenna erected over the 1,000,000-volt generator. The diagram of high voltage test setup is shown in Figure 5.

The tests were accomplished by observing and photographing corona pulses and blanking pulses simultaneously on the dual channel H-T Oscilloscope Model 1E. Results of the above tests are shown by the photographs of Figure 6.

Several deficiencies can be noted from the photographs. Perhaps the most serious fault is the narrowing of the blanking pulses. The effect of this pulse narrowing will be fully discussed in the paragraphs concerning the constant repetition rate pulse-pair tests.

Another defect can be noted in Figure 6A which illustrates that the blanking pulse generator did not fire for an isolated corona pulse of considerable amplitude. The MV sensitivity control was not set at a maximum; however, it can be seen from the picture in Figure 6B that the multivibrator was firing on very much smaller pulses at higher repetition rates. The seriousness of this "sleeping sickness" depends upon the frequency with which it occurs. Only a few such instances were observed, but it must be remembered that only a small percentage of the total time was sampled. This condition could not be analyzed because of the scarcity of its occurrence but is hereby reported for future reference.

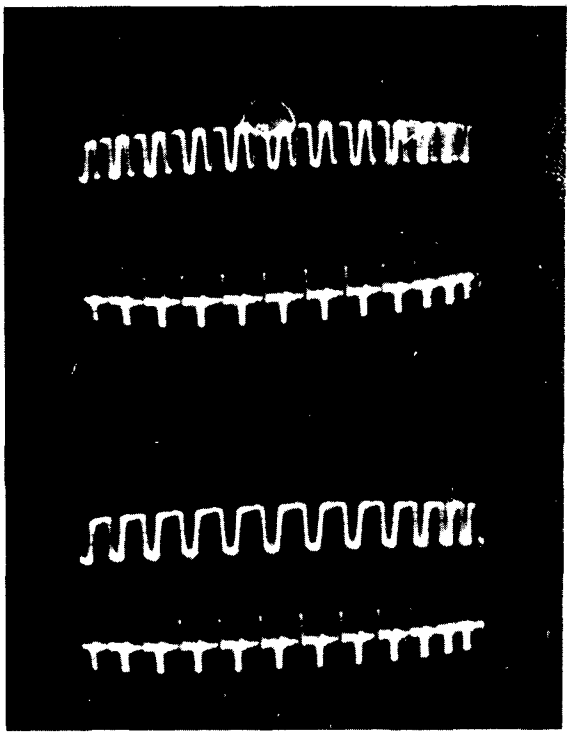
Using pulses from the Colonial and the Hewlett-Packard pulse generators, the steady repetition rate performance of the pulse channel was checked. It was found that the blanking pulse generator would trigger on positive or negative pulses as small as three millivolts at a repetition rate of 5,000 pulses per second at full sensitivity. To obtain these small pulses, a differentiating circuit consisting of a 14-uufd condenser and 3,000-ohm potentiometer was connected across the output of the Colonial Pulse Generator Model No. 700. The pulse amplitude was then calibrated with an r-f signal from the Measurements Corp. Model 82 Radio Frequency Signal Generator.

The input pulse amplitude had little effect on the blanking pulse except for a shift to a point earlier in time as the input pulse amplitude is increased. This time shift reaches a maximum of about 1/2 microsecond at about 50 millivolts of input pulse, at full sensitivity. At one half sensitivity the minimum trigger voltage is about 40 millivolts, and the maximum time shift is reached at about 100 millivolts.

Input pulse width between 0.5 microseconds and 8.0 microseconds has no effect on the blanking pulse. Input pulses wider than 8.0 microseconds will cause the multivibrator to retrigger on the trailing edge of the input pulse. This is probably due to differentiation of the wide pulses within the pulse channel.

The maximum steady state repetition rate of the blanking pulse generator was determined by using the differentiated output of a Tektronix, Inc. Square Wave Generator Type 105 as the input to the Interference Blanker MX-1077(XA)/U. It was found that the multivibrators began to count down at about 1,200,000 pulses per second at full sensitivity, and at about 700,000 pulses per second at half sensitivity. Figure 7 shows that the blanking pulses narrow considerably when this repetition rate is attained. The amplitude of the triggering pulses in this case was about 12 millivolts peak. The point at which the multivibrators count down is a function of the trigger pulse amplitude and the multivibrator sensitivity control setting.

Further constant repetition rate triggering tests were made with an applied radio frequency signal. It was found that the minimum triggering voltage occurred at a frequency of about 700 kilocycles. This value, at full sensitivity, was 4.2



A: MV Output
Input = 1,180,000 PPS

B: MV Output
Input = 1,200,000 PPS

FIGURE 7

DIFFERENTIATED SQUARE WAVE AND RESULTING BLANKING PULSES

millivolts peak, and at half sensitivity, it was 42 millivolts peak.

Pulse Channel performance on close spaced pulses was determined by coupling the Colonial and the Hewlett-Packard Pulse Generator outputs and feeding the results to the blanker model as shown in Figure 8. In this way two pulses can be obtained having a spacing which can be varied with the pulse delay control on the Hewlett-Packard Pulse Generator.

Results of tests with the above-described input pulses are shown in Figure 9. Figure 9A shows triggering pulse-pairs and the resulting blanking pulses. Traces 3 and 4 of Figure 9A display the pulses on a 5 microsecond sweep, and it can be noted that the second blanking pulse has narrowed considerably as the interval between the pulses is decreased.

Figure 9B shows the unblanked output of the Blanker superimposed on the blanking pulse and blanked output of the Blanker for two different intervals between input pulses. The oscillations present near the second pulse of the output waveforms are due to radiation from the Hewlett-Packard Pulse Generator and should be discounted. Traces 3 and 4 show the input pulses spaced so as to give two close spaced blanking pulses. The second pulse is narrow and the effect of this narrowing is evident in the output waveform which shows that the trailing

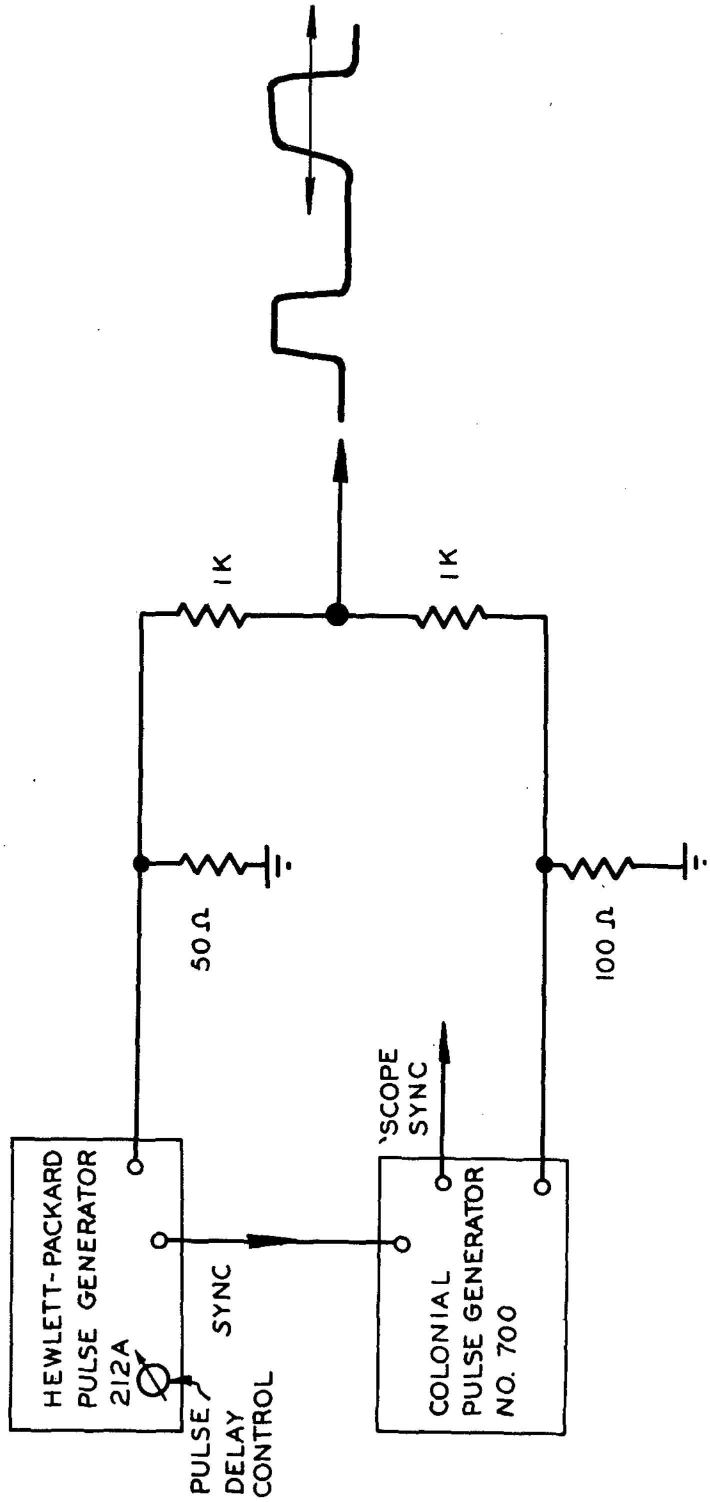
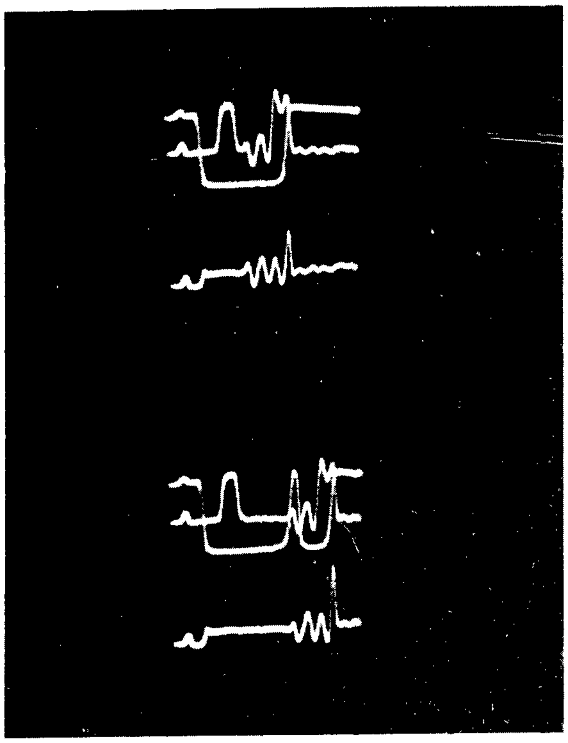
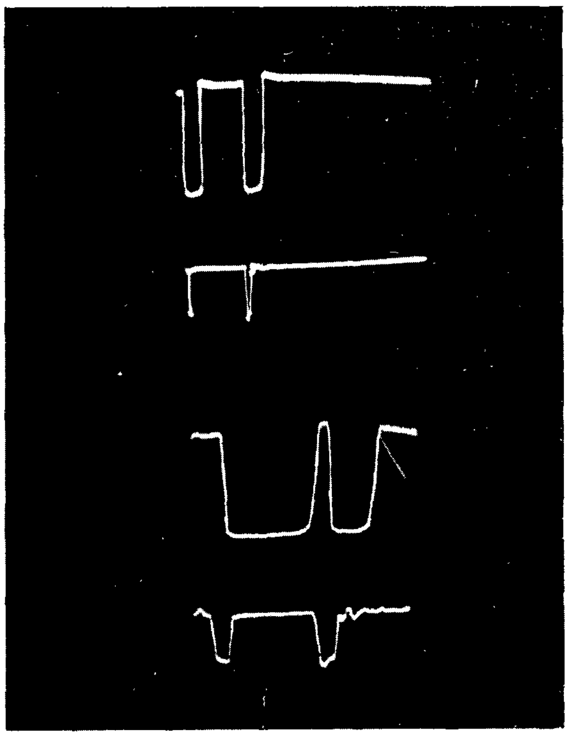


FIGURE 8

DIAGRAM OF PULSE GENERATOR COUPLING NETWORK
FOR DOUBLE PULSE OUTPUT



1. Unblanked Output superimposed on Blanking Pulse.
2. Blanked Output Sneak-Through.
3. Unblanked Output Superimposed on Blanking Pulse and Foreshortened 2nd B.P.
4. Blanked Output Sneak-Through.



1. Completed Blanking Pulses on 25 us Sweep.
2. Trigger Pulses.
3. Close Spaced Blanking Pulses on 5 us Sweep, Showing Foreshortening.
4. Trigger Pulses for Trace 3.

A

FIGURE 9

CLOSELY SPACED PULSES AND RESULTING BLANKING PULSES edge of the interfering pulse was left unblanked. The same result is evident in traces 1 and 2 where the input pulses are spaced so that only a single, normal width blanking pulse is generated. If the pulses had been spaced a little closer than shown on trace 1, they would both have been blanked out by the single blanking pulse. If they had been spaced a little further apart than shown on trace 3, the second blanking pulse would have been sufficiently wide to blank the second interfering pulse. It is during this small interval in time on the horizontal axis, that the blanking pulse generator is incapable of blanking out the entire pulse. This invalidates the blanking action for the given noise pulse and results in unwanted effects in receiver. Further evidence of this is given in Appendix C where the coincidence stage is discussed.

The pulse channel of Interference Blanker MX-1077(XA)/U is not acceptable since Paragraph 3.3.8.4 of Exhibit No. MCREE-685 requires that the width of the blanking pulse be automatically extended upon the arrival of other triggering pulses before the completion of any blanking pulse.

APPENDIX C

COINCIDENCE CHANNEL

The coincidence channel tested consists of circuitry as shown in Figure 10. This is a simplified schematic.

The signal and noise pulses are amplified in the paralleled amplifiers and fed in phase to the terminals A and B. When no blanking pulse is present, the signal and noise is placed on the grid of the cathode follower through the high conductivity of the IN69 crystals. However, with a blanking pulse present at terminals C and D, the noise is blanked out since the IN69 crystals are then in a condition of low conductivity so that very little or no signal and noise should appear at the grid of the cathode follower. The condition of low conductivity causes a greater signal and noise voltage drop to appear across the crystals than across the grid resistor of the cathode follower.

The above introduction sets forth the circuitry and basic requirements of the coincidence channel. Within a limited range of operation the channel is satisfactory, but the results of the tests conducted in the Communication and Navigation Laboratory indicate that much is still lacking, not alone in coincidence stage but in over-all operation of the blanker.

Observed residuals (the remnants of transient resultants of blanking action after balancing) of eight to ten millivolts resulted at best balance with an input of one half microsecond pulses at 5,000 pulses per second and approximately 200 millivolts amplitude from the Colonial Pulse Generator Model 700. An a-c pickup of approximately eight millivolts (400 and/or 800 cycles per second) occupies the blanked interval. A hump or bounce (over shoot) as shown in Figure 13, with amplitude of 35 millivolts was present after the blanked interval. This causes an increase in residuals with resulting displacement of the base line (r-f axis), thus increasing the over-all noise level of the blanker.

Figure 11 shows the resulting wave shape at the output of the blanker. This figure was sketched from the DuMont Oscilloscope Model 248A (248 scope) and Tektronix Pre-Amplifier Type 121 (pre-amp 121).

It has been found that the bounce under corona conditions can be reduced in amplitude to approximately 20 millivolts by appropriate decoupling measures such as shown in Figure 12, but the resulting residuals were still too great to meet specifications. Figure 13 shows that when two successive pulses appear within 50 to 20 microseconds of each other, the bounces are additive so as to increase the residuals to approximately twice the previous conditions when only one pulse was present.

The a-c pickup riding within the blanked interval appears to be pickup from a strong filament field and/or a ripple riding on the B+. It appears, after observing a large number of single sweep photographs taken with a dual-channel H-T Oscilloscope Model 1E, that the blanking axis could possibly follow the peaks and valleys of the a-c pick-up, producing a minor shift in the axis. This is

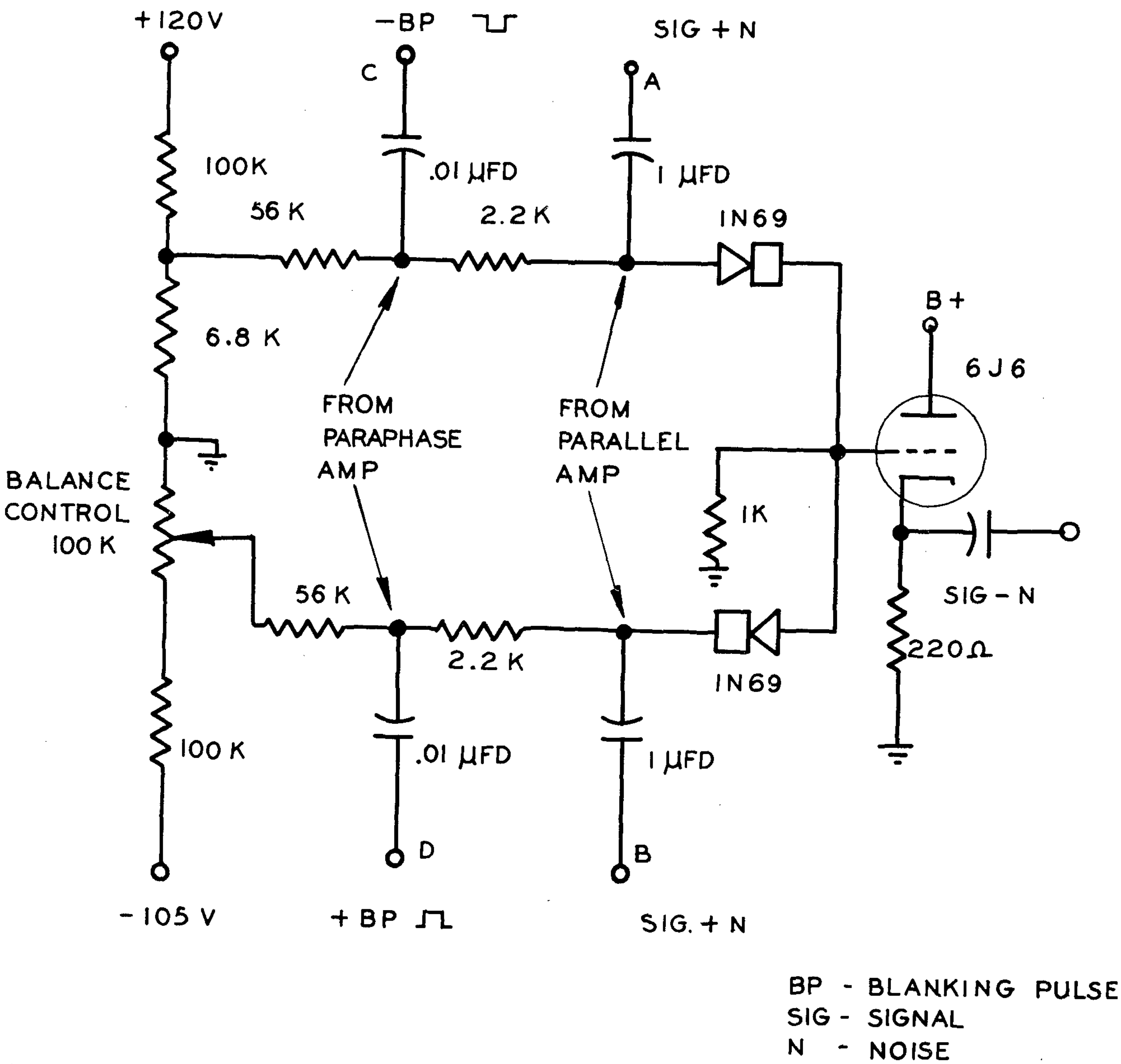


FIG. 10

COINCIDENCE CHANNEL

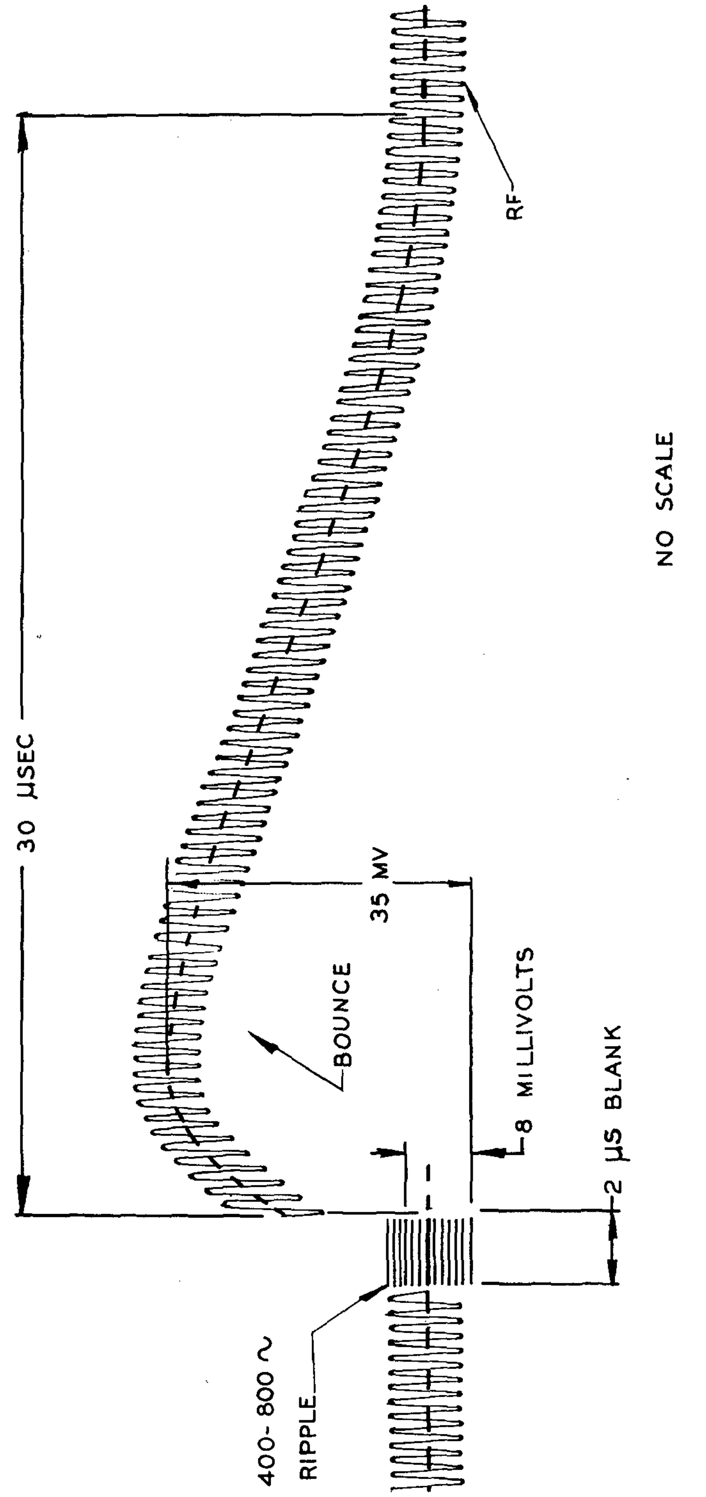


FIG. 11

SKETCH OF APPROXIMATE AMPLITUDE AND SHAPE OF BLANK AND BOUNCE

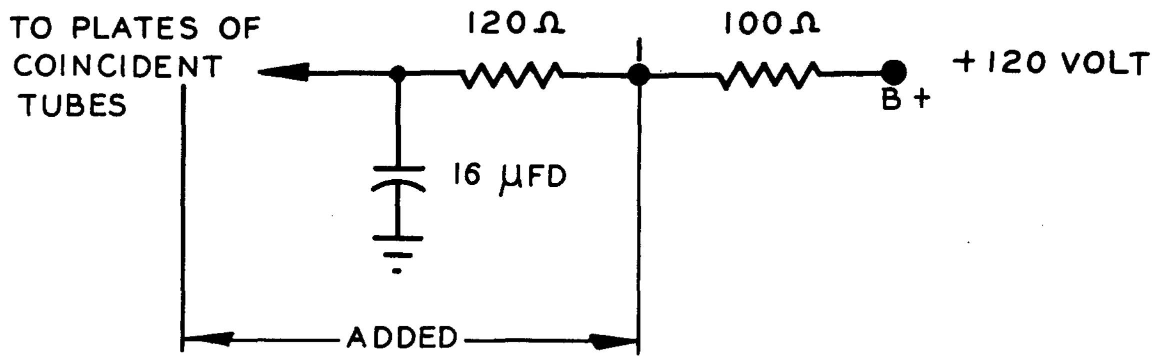


FIG. 12

POSSIBLE DECOUPLING CIRCUIT

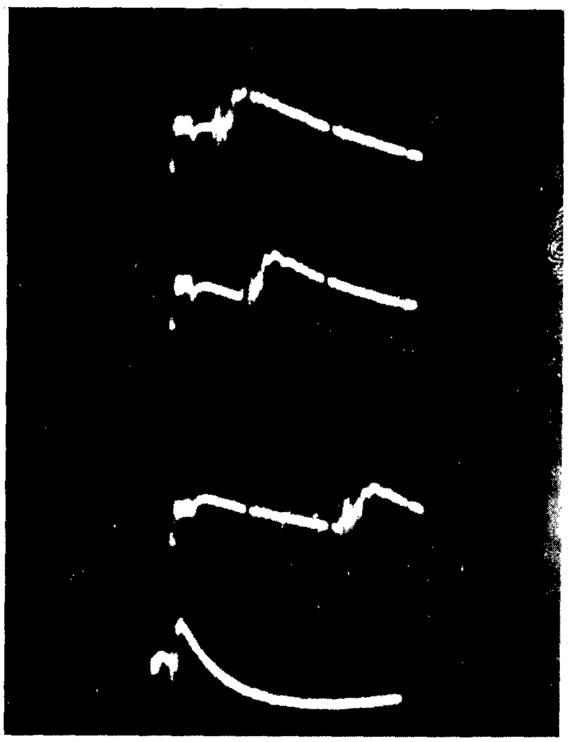
illustrated in the sketches shown in Figure 14.

The residuals from the IN69 crystal operation may be reduced to approximately eight or ten millivolts (by balancing) under constant repetition rate conditions. The balance control is not critical. The addition of capacity to either side of the crystal circuit did not improve the balanced condition.

With the cover on, the blanker heated so badly that continuous rebalancing was necessary and balance could not be arrived at after an hour of operation.

The noise pulse blanked out was within the 200-millivolt maximum range specified. Above that amplitude at constant repetition rate to the blanker, the ride-through (that portion of the noise pulse which may appear during the blanking interval) becomes apparent. The single sweep pictures taken from the 248A scope screen bear out the fact that ride-through was present but generally less than the amplitude of the maximum residuals. See Figure 15.

A crystal feed-through check was set up wherein the crystals were cut off (placed out of conduction) by a fixed bias. This simulated a blanked condition of the coincidence circuit. A random noise (corona) source (see Figure 5) was set up and 85 microamperes of corona current were applied to the input of the blanker. The output of the blanker was applied to the input of the National Company Model NC-100 Receiver. The S-Meter readings of the receiver indicated the relative noise levels of the blanker. With no corona, the S-Meter read S3 units. At 85 microamperes of corona directly applied to the input of the receiver, the S-Meter indicated S9 plus 20db. At 85 microamperes of corona current into



(a)

(b) Traces (a), (b), and (c) Blanked output showing second blank at various distance from the first. 10 microsec. markers, 25 microsec. sweeps.

(c)

(d) Second blank is high on hump of first blank - Humps Add 100 microsec. sweep, 10 microsec. markers.

NOTE: Used Scope 248A full gain and Pre-Amp 121 full gain, land camera.

FIGURE 13

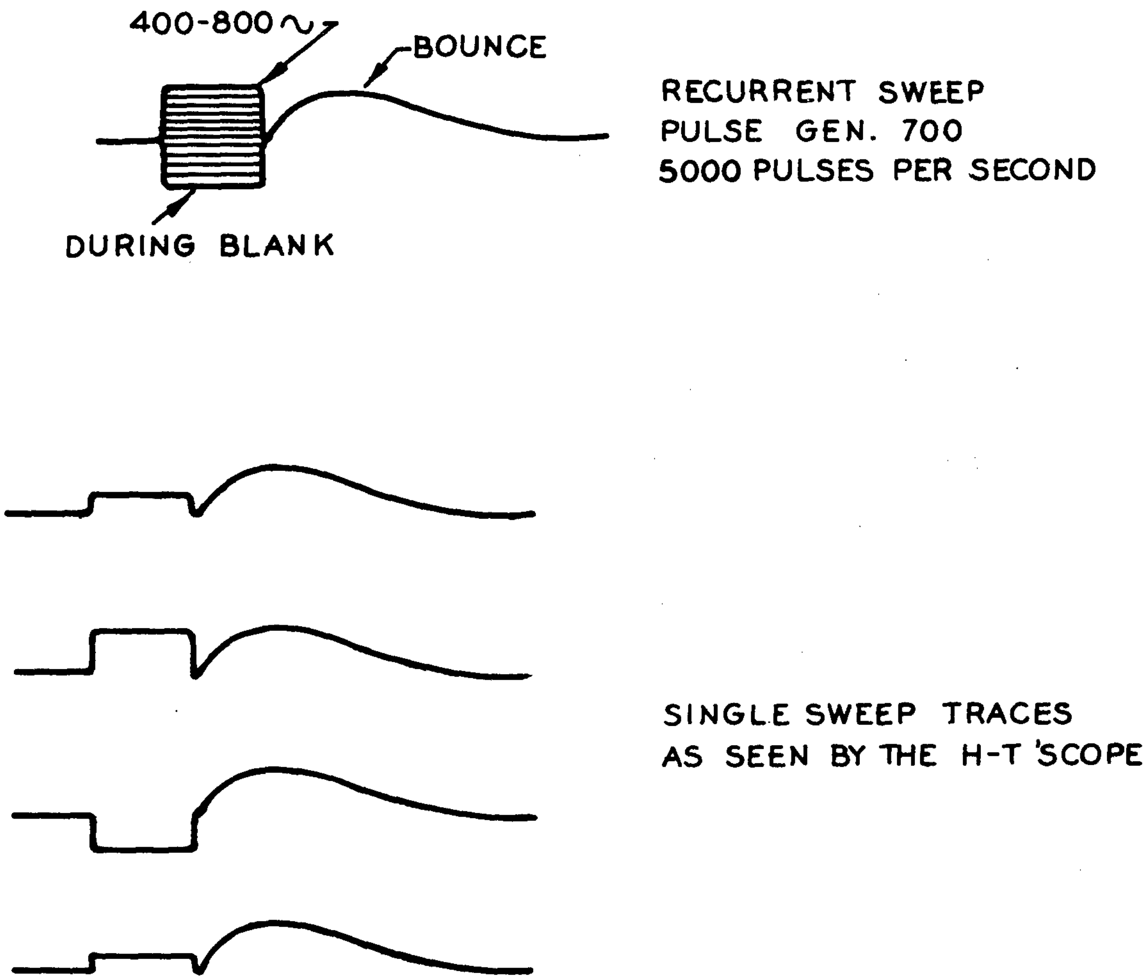
EVIDENCE OF BASE LINE SHIFT AFTER EACH BLANKED NOISE PULSE

the blanker connected to the input of the receiver (with the blanker crystals cut off as stated above) the S-Meter indicated S8 showing that there is apparently considerable feed-through. Figure 16 shows both battery and bleeder methods used in biasing the crystals.

The output of the coincidence stage is shown in Figure 17 and 18. The transients are a result of the deficiencies in the coincidence and pulse channel operation. Figure 18A illustrates the output of the blanker with apparent results of deficiencies as listed below:

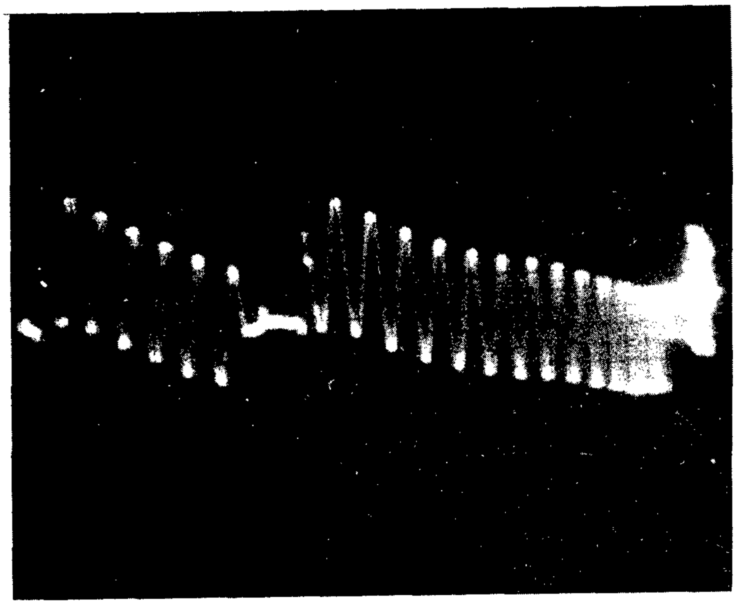
1. "Ride-through" during the first blanking interval.
2. First blank extended but not sufficiently to cover second noise pulse.
3. Second blanking pulse riding on the "bounce" of the first blank.
4. The first blank riding in the trough of a bounce caused by a previous blank.

The residuals shown are approximately 20 millivolts peak.



THE ABOVE SKETCHES SHOW THAT BLANK WILL APPEAR AT VARIOUS LEVELS DEPENDING ON THE INSTANT THE PICTURE WAS TAKEN.

FIG. 14



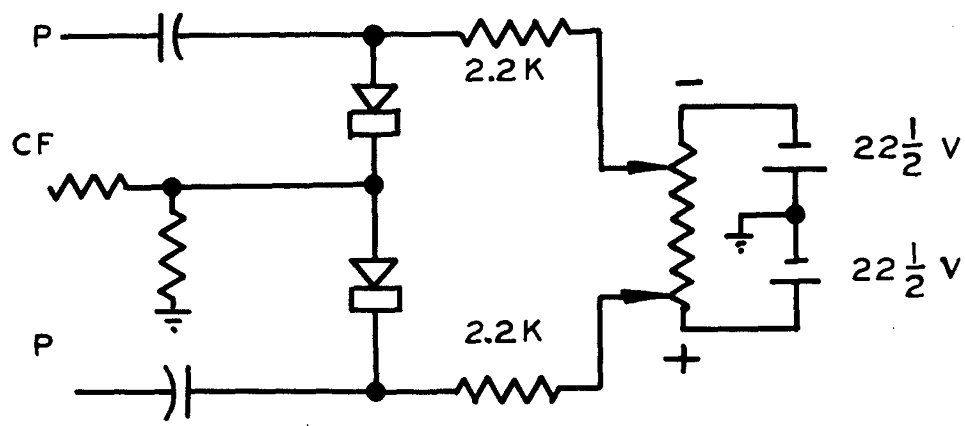
RF: 20 mv peak to peak
SWEEP: 25 Microseconds
CARRIER FREQ: 1 Megacycle

FIGURE 15

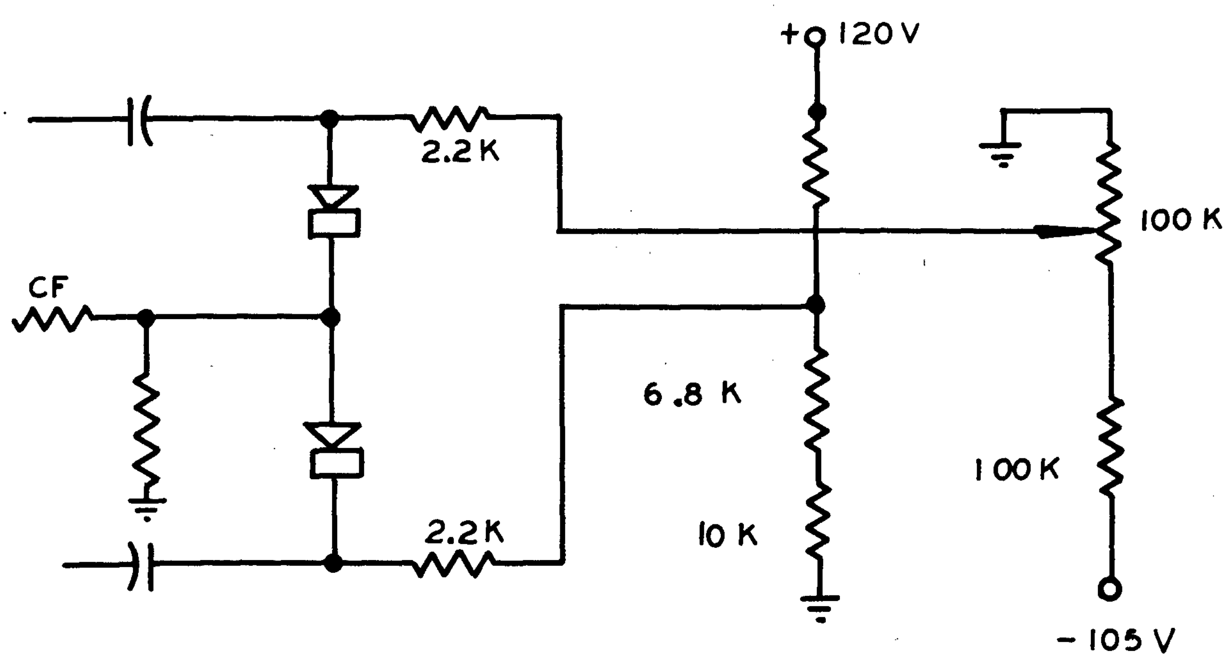
RIDE-THROUGH DURING THE BLANK

Figure 18B shows the same results as in Figure 18A except that the blanking axis is at a lower level in respect to the mean r-f level. This may be a result of blanking axis shift caused either by the a-c pickup variation as discussed previously, or by change in repetition rate of the noise source.

Figures 17A and 17B illustrate the retatively large composite residuals of magnitudes of from 40 to 50 millivolts. This decidedly shows the unsatisfactory operation of the blanker.



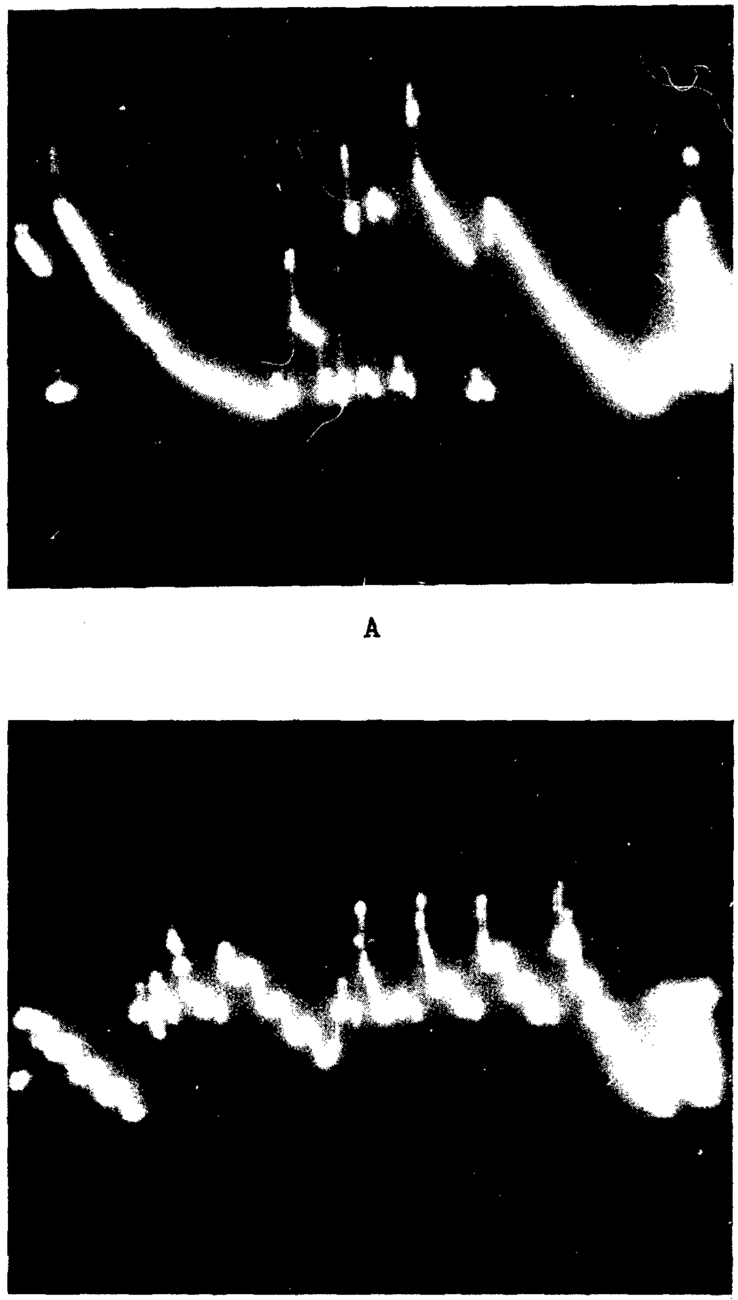
BATTERY METHOD



BLEEDER METHOD

FIG. 16

(REFER TO FIGURE TEN)



A

B

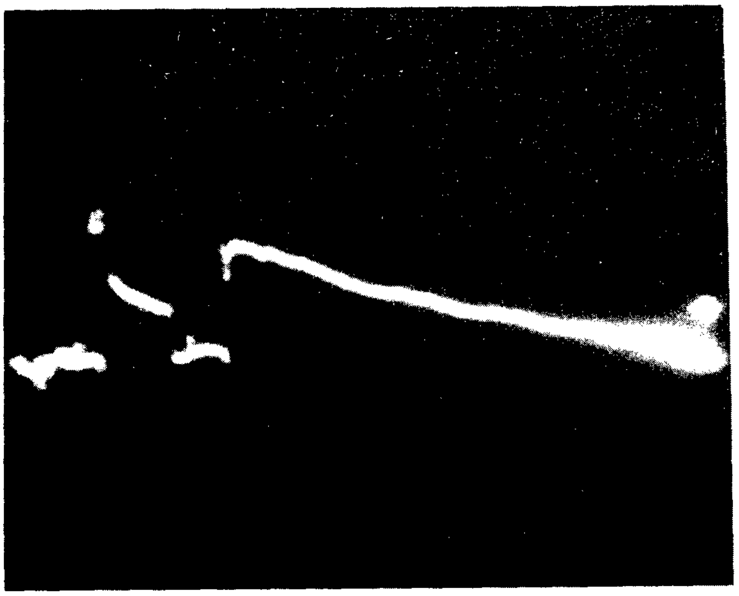
FIGURE 17

SINGLE SWEEP OUTPUT OF COINCIDENCE STAGE

Trace A and B
- 100 Microsec. Sweep
- 27 MV per inch peak to peak

NOTE: Used the DuMont 248A Scope, Tektronix Pre Amp #121 and Fairchild Oscillo-Record Camera.

A



B

FIGURE 18

SINGLE SWEEP OUTPUT OF COINCIDENCE STAGE

Trace A and B
- 25 Microsec. Sweep
- 27 MV per inch peak to peak

NOTE: Used the DuMont 248A Scope, Tektronix Pre Amp #121 and Fairchild Oscillo-Record Camera.

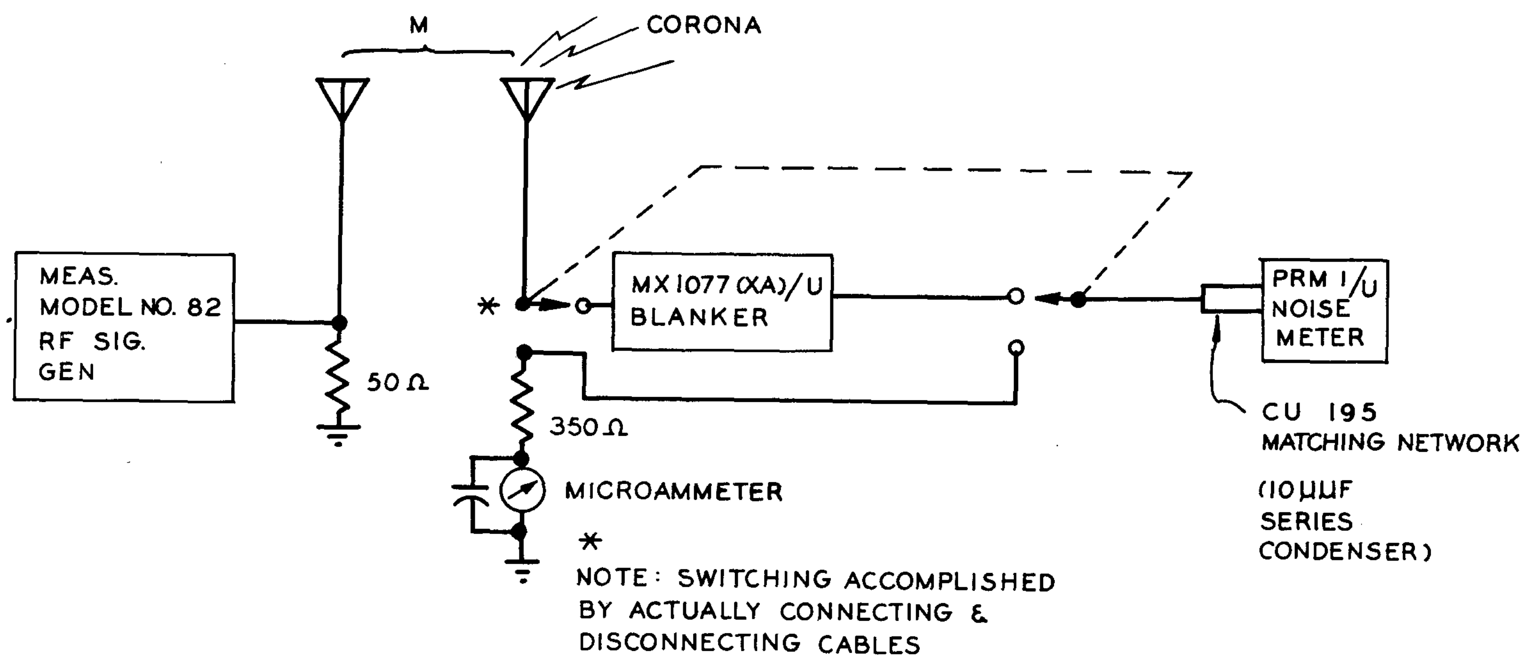


FIGURE 19

DIAGRAM OF TEST SETUP FOR PERFORMANCE TESTS OF MX 1077 (XA)/U INTERFERENCE BLANKER

APPENDIX D

OVER-ALL PERFORMANCE

Over-all performance characteristic tests of the blanker were first conducted using Radio Receiver BC-348 with a VTVM connected to the audio output. The tests were conducted in a manner similar to the tests described below. The results thus obtained were misleading due to the dynamotor hum and other receiver noise in the BC-348 which masked the residual noise of the blanker. Consequently, the tests were discarded.

An AN/PRM-1 Noise Meter, Measurements Corp. Signal Generator Model 82, and H-T High Voltage Generator HVG 4 were used in the tests. See Figure 5 for antenna and high voltage corona setup.

The antenna was terminated in its characteristic impedance of about 350 ohms and was fed directly into the noise meter. With all equipments operating, the base noise level was noted. This value varied between one and three microvolts throughout the tests. With the antenna still connected to the noise meter, the voltage of the H-T Generator was brought up until the receiving antenna went into negative corona. This zero signal noise level was noted on the noise meter, and then the r-f signal voltage was applied to the transmitting antenna and its voltage was increased to the point where the signal plus noise voltage was equal to twice the noise voltage. (S+N=2N). This r-f signal voltage was arbitrarily called the minimum readable signal voltage. The antenna was then connected to the blanker and the noise meter was connected to the output of the blanker, and the above measurements were repeated with the blanker pulse channel inoperative and operative. The "pulse channel inoperative" tests were made to determine whether any noise improvement or signal degradation was inserted by the blanker delay line and/or video circuits. The "pulse channel operative tests" were made to determine the over-all performance of the blanker. Figure 19 shows the block diagram of the test setup.

These checks were repeated for various values of corona current from zero to 100 microamperes and for several frequencies within the passband of the blanker. The results are shown on the curves of Figures 20, 21, 22, and 23. Figure 20 shows how the minimum readable r-f signal varies with corona current at 245 KC. The solid curve shows the effect of corona on minimum r-f signal when the antenna was fed directly to the noise meter. The dashed curve shows that the blanker video channel has little effect on the minimum r-f signal. The dotted curve was taken with the pulse channel operating and the difference between the solid curve and the dotted curve is a measure of the improvement in the minimum signal due to the blanker. The distance from the solid line down to the 10 microvolt line is the improvement desired. Figure 21 shows the minimum r-f as a function of frequency at 50 milliamperes of corona current.

The curve in Figure 22 shows noise level due to corona alone when the blanker is out of the circuit and when the blanker is in, and operating. The difference between the curves for each frequency is the noise improvement in decibels due to the blanker. The curves are given for the frequency extremes. The noise level represented by the "blanker on" curves consists of the blanking residuals, or

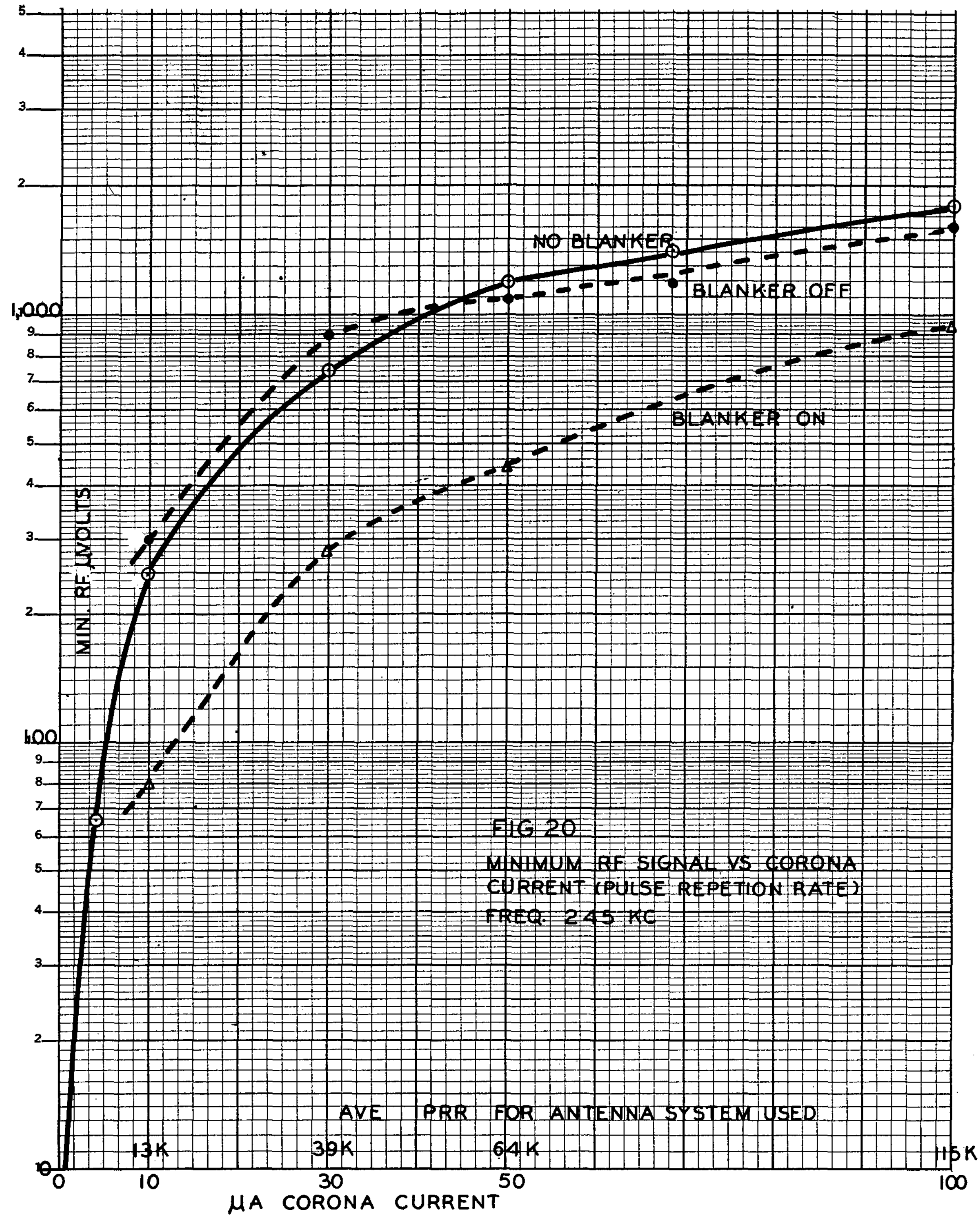


FIG 20
MINIMUM RF SIGNAL VS CORONA CURRENT (PULSE REPETION RATE)
FREQ. 245 KC

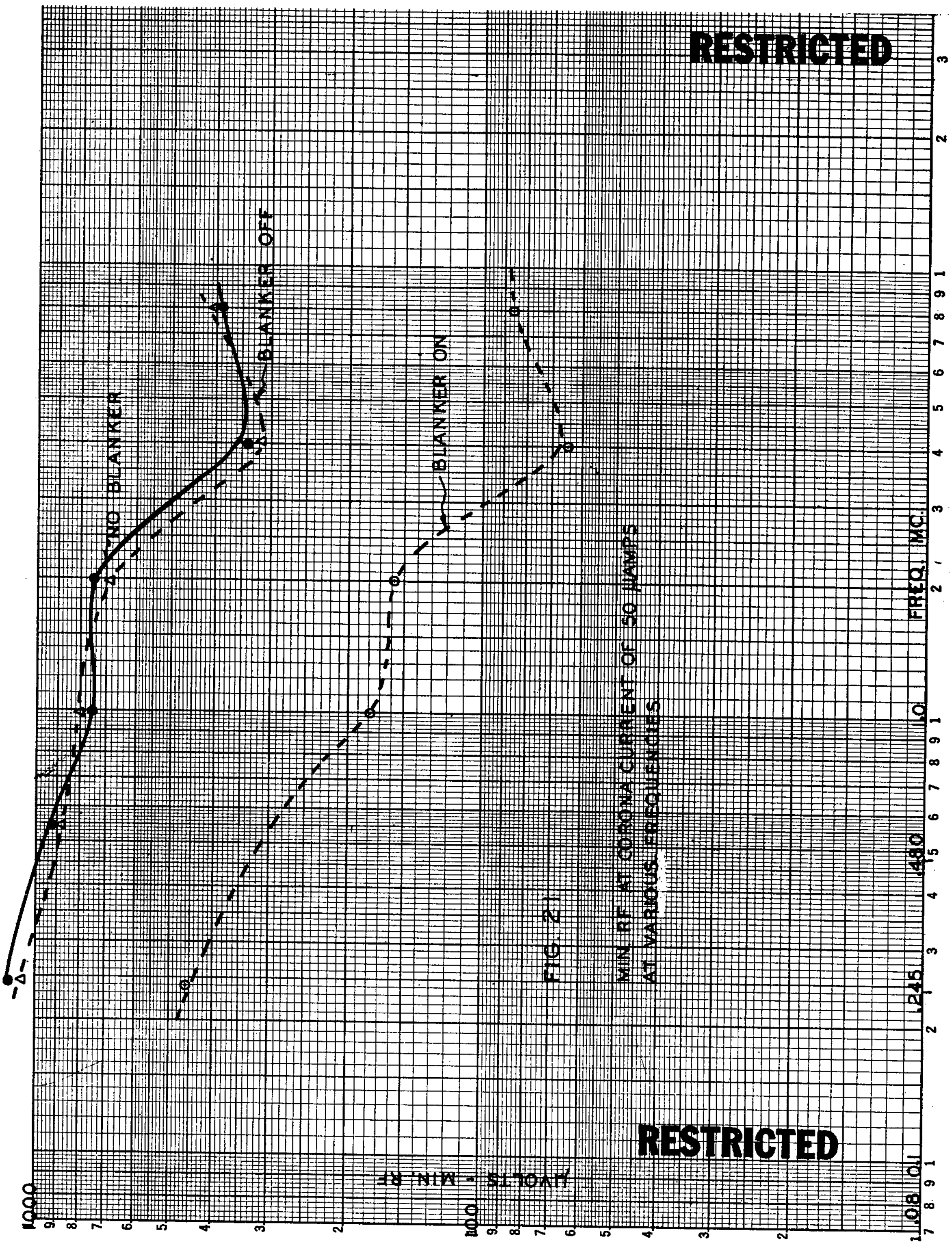


FIG. 21

MIN. RF AT CORONA CURRENT OF 50 μAMPS AT VARIOUS FREQUENCIES

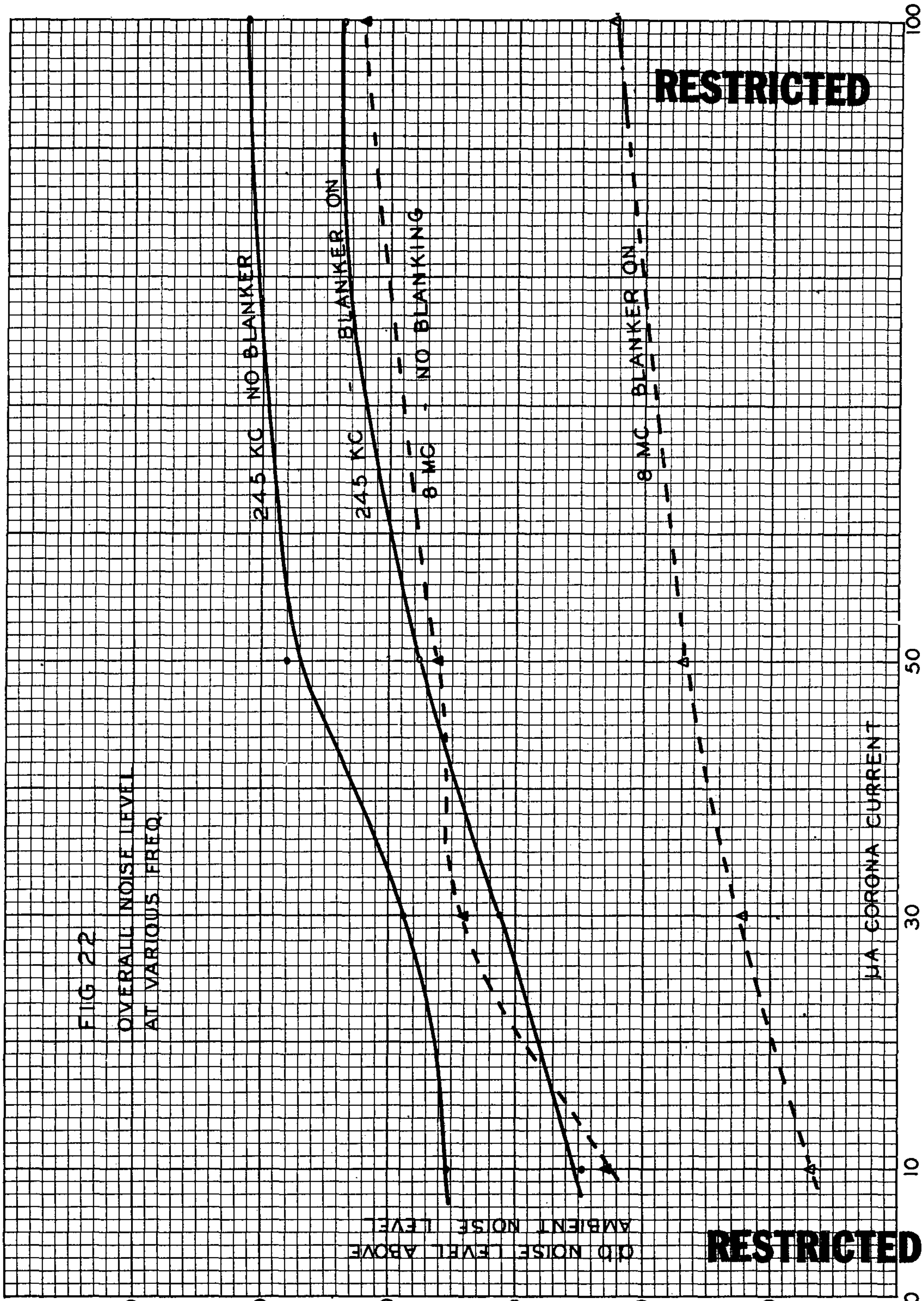


FIG 22
OVERALL NOISE LEVEL
AT VARIOUS FREQ.

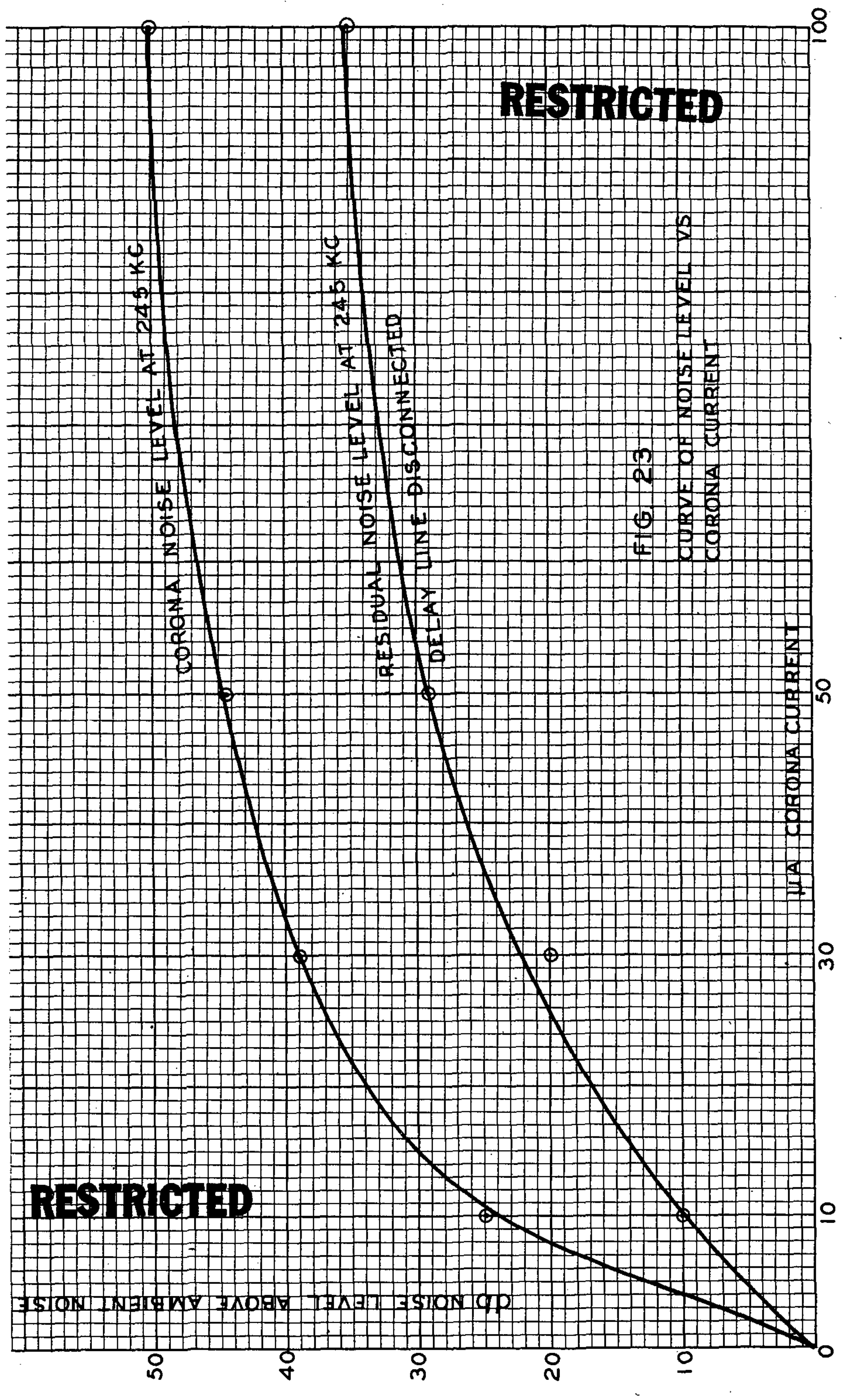


FIG. 23
CURVE OF NOISE LEVEL VS CORONA CURRENT

switching transients, unblanked corona pulses and partially blanked corona pulses.

The noise due to blanking residuals alone is shown in Figure 23. To determine this curve, the delay line was disconnected to invalidate the signal channel, so that the signal applied to the noise meter consisted only of blanking residuals. The curve was taken at 245 KC, the worst case. This demonstrates that the Polarad Blanker still leaves much room for improvement.

The curves mentioned above also give the average pulse repetition rate for the various values of corona current used. These values were determined as described in the C&N Laboratory Memorandum (AF TR No. 6571) entitled, "Number and Time Distribution Properties of Corona" dated 2 July 1951. Figure 24 shows a chart of corona current versus average pulse repetition rate and the deviations from the average.

FIGURE 24

Ic	AVE PPS	MIN PPS	MAX PPS
10	13000	12000	14000
30	39000	35000	42000
50	64000	58000	69000
100	115000	108000	122000

APPENDIX E

MISCELLANEOUS

The physical over-all size of the blanker is that of a 1/2 ATR unit.

A physical discrepancy of the blanker is that of not standing level of its shock mounts. This can be rectified by mounting the power transformer at the center of balance of the chassis and closer to the bottom of the unit so as to lower the center of gravity to eliminate the top heavy condition.

Microphonics are present to such an extent that the slightest vibration would upset operation of the circuit.

It is recommended that a cooling system such as a blower or a greater use of louvers be used to stabilize the ambient temperature of the unit to a value sufficiently low so as to retard or remedy the drift of the coincidence crystals (which was discussed in the coincidence section) and to increase the working life of the electrical components of the blanker.

The accessibility of pulse channel and/or any of the other channels is relatively good in regard to 1st and 2nd echelon work, but in any work on electrical circuits within each subchassis, patch cables may be needed to increase accessibility thus to increase the scope and efficiency of trouble shooting in any of its stages.

A great deficiency is the lack of complete use of JAN approved components.

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