

EFFECT OF PRESSURE, NOZZLE SPACING AND HEIGHT ON
THE DISTRIBUTION PATTERN OF AN AGRICULTURAL FIELD SPRAYER

by 683

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INTRODUCTION

A large percentage of the farmers use Agricultural Field Sprayers to control insects, pests and plant diseases by applying liquid insecticides and fungicides. Some farmers even use herbicides to kill weeds either discriminately or selectively, spray defoliate or condition crops for mechanical harvesting and application of plant nutrients. A perfect control with chemicals cannot be expected until and unless proper adjustments in the equipment are made. A poor application can easily cause extensive damage. Spraying for weed and insect control is a precision operation. It has a tremendous potential for saving a crop or increasing yield, but misuse may completely ruin a crop.

The nozzle is the all important mechanism which breaks the spray liquid into the desired size of droplets for application to the surface to be sprayed. The selection of the nozzle should be such that the proper particle size and application rate are within the recommended range of pressure.

The pressure necessary to force the spray solution through the nozzle of the sprayer plays a vital role. The spray pressure should be regulated in such a way as to give proper nozzle discharge rate, spray pattern and a desired distribution.

The proper location of the nozzles depends on the type of spraying being done. The spacing of the nozzles should be such that the target area will be covered with a minimum amount of spray escaping from the desired area and falling onto or drifting into an undesired area.

The ground speed should be regulated to apply the correct rate and be kept uniform. Higher ground speeds permit the use of nozzles with larger

orifices to apply the same rates as would be applied at a lower speed with smaller orifices. If the same nozzles and pressure are used, application rates are lower at the higher speed.

The points discussed above are important and closely related to each other. A single variation from the requirements may result in poor control or extensive damage. The rate of application should be as economical as possible and still provide a good control measure.

PURPOSE OF INVESTIGATION

Two types of nozzles, the hollow cone and the flat fan, which are most commonly used on agricultural field sprayers have been used in this investigation. The purpose of this investigation is to show the comparative difference in the distribution patterns between the fan and cone type nozzles by varying pressure, nozzle height and nozzle spacing, which are the prime factors.

For any particular set of nozzles a specific pressure is required to give a desired distribution pattern and size of spray particles. Penetration and distribution are a function of pressure with a given nozzle. Maximum penetration or drive is obtained with large droplets at high pressure, but increasing the pressure on a given nozzle reduces the droplet size. Distribution is good with smaller droplets, but the smaller the droplets are, the more they are susceptible to drift.

The nozzle spacing on the boom depends upon the type of crop to be sprayed. For row crops, the usual arrangement is one nozzle directly over each row, with the boom height adjusted so that the spray fans meet between the rows. Where crops in the rows are too far advanced to permit spraying

of the foliage, nozzles may be placed to center between the rows. The fans will meet at the base of the rows without wetting the crop plants. For open field work such as grain and alfalfa spraying, nozzle spacing should be uniform to give a complete coverage.

The type of spray coverage required and the characteristics of the nozzles will determine how high the boom has to be above the spraying surface. If the boom is too low, coverage is incomplete with gaps between the nozzle patterns and if the boom is too high, it gives improper coverage where the nozzle spray patterns overlap. It is important that the height of the boom should be adjusted to obtain the correct distribution pattern and type of coverage required.

REVIEW OF LITERATURE

The need for more efficient application of spray in the field has been shown to be of prime importance in reports of tests made during the past several years. Some of the earliest attempts to use sprayers were made for the application of fungicides in controlling diseases of grapes in vineyards in the vicinity of Bordeaux, France. The hand sprayer to combat insects was developed between 1850 and 1860 by John Bean of California, D. B. Smith of New York, and the Brandt Brothers of Minnesota (5).

Nozzle placement and distribution should be such that a maximum of the leaf surface of the plant will be exposed to the spray pattern. The amount of pressure and nozzle type should be such that the individual spray particle travels with minimum velocity as reported by Slosser (6).

As the pressure is increased from 30 psi to 40 psi in fan type weed spray nozzles, the angle or width of coverage is increased as reported by

Barger et al. (11). The uniformity of the application is essentially the same as with the 30 psi pressure. The best combination of the nozzle angle and height for uniform distribution should be obtained. The height of the spray pattern should be such as to concentrate the spray on the weeds. In spraying pastures, lawns and small grain fields it is desirable to cover all the ground and not double treat any portion.

Two types of nozzles have been studied by Akesson (7). The nozzles producing a flat fan shaped spray are considered to give the most uniform coverage and strongest drives, while nozzles producing cone shaped discharge are used in some cases for extremely fine sized particles. A compromise must be made and an optimum pressure used which will give satisfactory penetration without serious drift. The nozzle fan width and spacing on the boom will determine the height of the boom.

A study by MacDonald (8) showed that close nozzle spacing allows the boom to be carried lower but with any given nozzle size this would increase the volume applied. A greater distance between the nozzles requires that the boom be carried higher to get uniform coverage. A recommendation was made keeping drift in mind; 15 to 18-in nozzle spacing would be satisfactory for small grain and 20-in spacing would be preferred for corn.

A typical feature of a nozzle has been reported by Kromer (9) in his studies. For a nozzle, a perfect spray pattern should be heavy at the center and taper out uniformly. When the nozzle is spraying in conjunction with another nozzle of similar characteristics, a uniform rate of application is obtained and height variation has less effect on the uniformity of spray application.

An investigation by Rice (10) showed that a sprayer having a swirl type nozzle formed the spray into a thin-shelled hollow cone and the distribution pattern from these nozzles was roughly rectangular in shape, but the center of the pattern received less application than the sides.

For most of the spray nozzles the pressure must be increased about four times to double the discharge rate as reported by Smith (4). Increasing the pressure also tends to decrease the droplet size of the spray delivered thus affecting the distribution pattern.

As reported by Bainer et al. (12) the height of the boom should be such that the overall width of each nozzle spray pattern at the deposition level is about 50 percent greater than the nozzle spacing. More over-lap is required for profiles having narrow peaks and less for steep sided profiles.

TESTING EQUIPMENT AND PROCEDURE

Fig. 1 shows the apparatus used for determining the spray pattern of spray nozzles. The test apparatus consists of a sheet of corrugated galvanized iron, 12 feet long and 4 feet wide with 1.25-in corrugations. The discharge collecting sheet is so mounted on the framework that it makes an angle of 5 degrees with the horizontal. A rack holding one hundred and thirteen 70 c.c. test tubes catches the runoff from each groove from the corrugated platform. The rack is hinged to the main framework so that all the tubes can be placed, removed and drained at the same time. A 3/4-in diameter pipe, 12 feet long is suspended above the platform to support the nozzles. The nozzles are clamped to the pipe. Both nozzle spacing and nozzle height are adjustable.

Explanation of Fig. 1

Test Apparatus used for Finding the Distribution
Pattern of Agricultural Sprayer Nozzles.

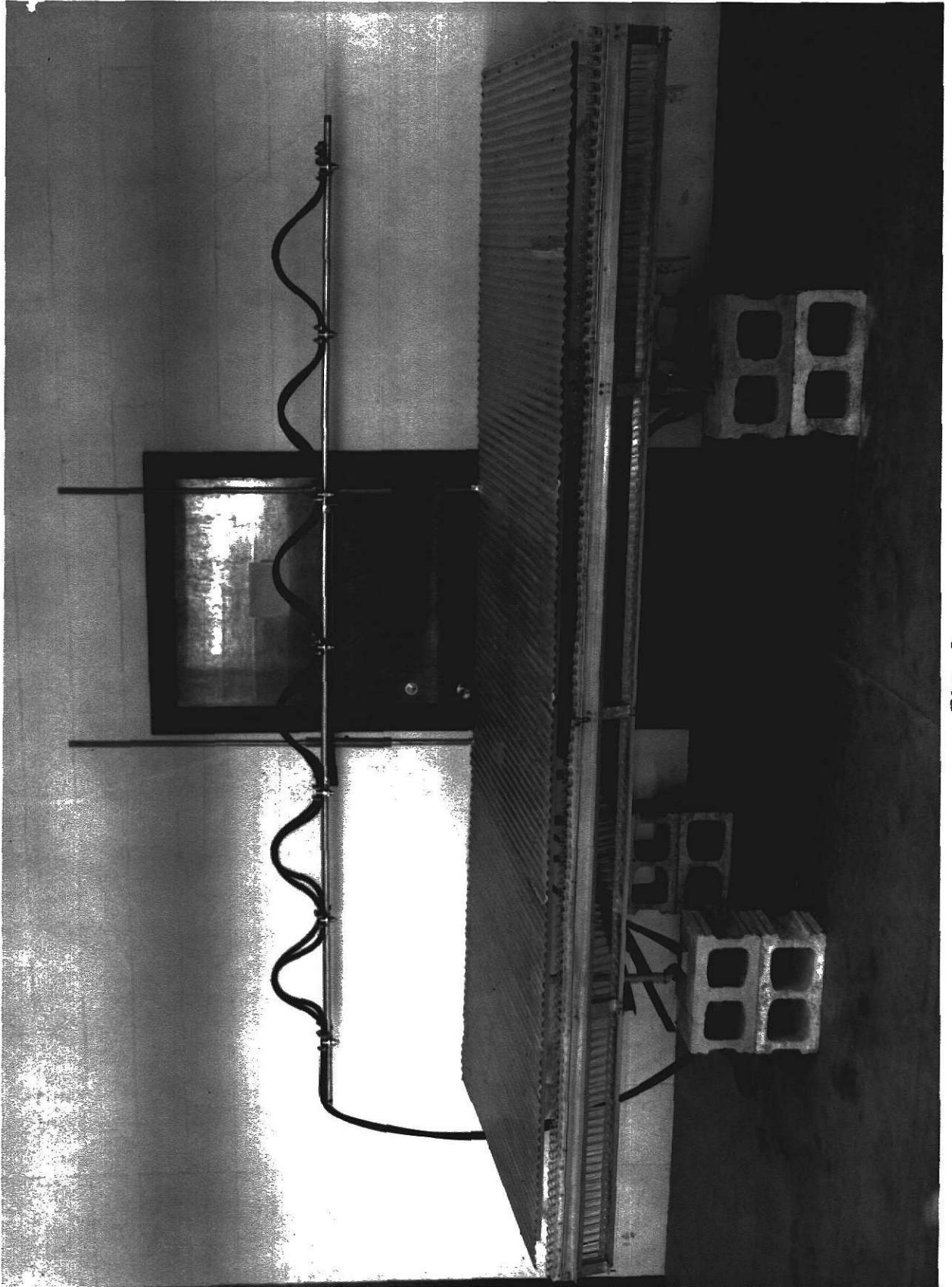


Fig. 1

As shown by Fig. 2 a platform was mounted under the corrugated iron to support an electric motor, pump and the necessary equipment for supplying liquid at desired pressure to the spray nozzles. A spring loaded bypass valve was used to vary the pressure. A selector type control valve made it possible to direct spray liquid to either of the two sets of nozzles simultaneously or independently. One twelve foot boom was equipped with fan type nozzles and the other with cone type nozzles for demonstration purposes.

Water was selected as the basic spray liquid because of the large number of chemicals used with it as solutions, emulsions or suspensions.

Two sets of nozzles were investigated. They were Spraying Systems flat fan type nozzle No. 730154 and Spraying System cone type nozzle No. TX3. The fan type nozzle had a spray angle of 73 degrees with a recommended nozzle spacing of 20-inches and nozzle height recommendation of 20 to 22 inches. The cone type nozzles had a spray angle of 80 degrees. Data and observations were taken in the laboratory to avoid the effect of wind drift on the distribution pattern. A scale with a hook at the top was placed on each test tube after each test to read the amount of discharge caught. The scale was marked to measure discharge in milliliters.

The equipment was set on blocks to a convenient height. The nozzle height and spacing was carefully adjusted. The pump was started and pressure was set to the desired amount. The on-off valve was opened to supply spray liquid to the nozzles and the pressure relief valve was readjusted to correct the pressure at exactly the value desired. The fans of the nozzles were adjusted so that the complete spray pattern would fall perpendicular to the test tray corrugations. The whole setup was allowed to run for about 5 minutes so that all the corrugations would start catching the

Explanation of Fig. 2

Test Apparatus Showing the Following Items:

Electric Motor

Pump

Relief Valve

Line Strainer

Pressure Gauge

Off-on Valve



Fig. 2

Explanation of Fig. 3

Side View of Test Apparatus and for Finding the
Distribution Pattern of Agricultural Sprayer Nozzles.



Fig. 3

discharge and constantly contribute to steady conditions. The discharge catching tube rack was placed under the corrugations and timing was clocked with a stop watch. A discharge catching time of one minute was set for all the readings taken for this experiment and the quantity measured in milliliters. After catching the discharge the amount caught per tube was measured with a calibrated scale and the readings were recorded. Similar readings were taken for 20, 25, 30, 40, 50 and 60 psi pressures for the same set of nozzles without disturbing them. Similar data were taken for the cone type nozzles at the same pressures as for the fan type nozzles.

In this experiment data were obtained on the effect of nozzle spacing for both cone and fan type nozzles. A pressure of 30 psi was selected from the previous study for the same set of fan type nozzles. The height of the nozzles was kept at 21 inches. The initial reading was taken with 16-in nozzle spacing. This was increased by 2-in increments each time, thus making the readings taken at 16, 18, 20, 22 and 24 inches. The nozzles on the boom were replaced by the cone type nozzles and data were taken with the same intervals of nozzle spacing, nozzle height and nozzle pressure.

The nozzle height adjustments were made in 4-in increments. Tests were run at 17, 21, 25 and 29 inch nozzle height settings.

RESULTS AND DISCUSSION

Effect of Pressure on the Distribution Pattern of the Flat Fan Type Nozzles

The results of varying the pressure for the Spraying Systems No. 730154 fan type nozzle is shown in Fig. 4 through Fig. 9. During these tests nozzle spacing was held constant at 20 inches and nozzle height fixed at 21 inches. It was interesting to note that the rate of application was greater directly under the nozzles at 20 and 25 psi as shown in Fig. 4 and Fig. 5, while the nozzle overlap zone had the greater rate of application at the higher pressures as shown in Fig. 7, Fig. 8 and Fig. 9. The most uniform rate of application for the conditions of this test was obtained with a pressure of 30 psi as shown in Fig. 6.

Effect of Pressure on the Distribution Pattern of the Cone Type Nozzles

The cone type nozzles, Spraying Systems No. TX3 were tested with the same nozzle spacing, height adjustment and range of pressure settings as for the fan type nozzles. The results are shown in Fig. 10 through Fig. 15. It was very apparent from the spray patterns which resulted that the nozzle spacing and height setting used were not correct for this particular nozzle. None of the six pressure settings gave a suitable degree of uniformity. At the 20 psi pressure setting, shown in Fig. 10, there was scarcely any application at the center of the overlap zone between the nozzles. The amount deposited directly under the nozzles decreased while that in the overlap zone increased as pressure was increased.

Explanation of Fig. 4

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet

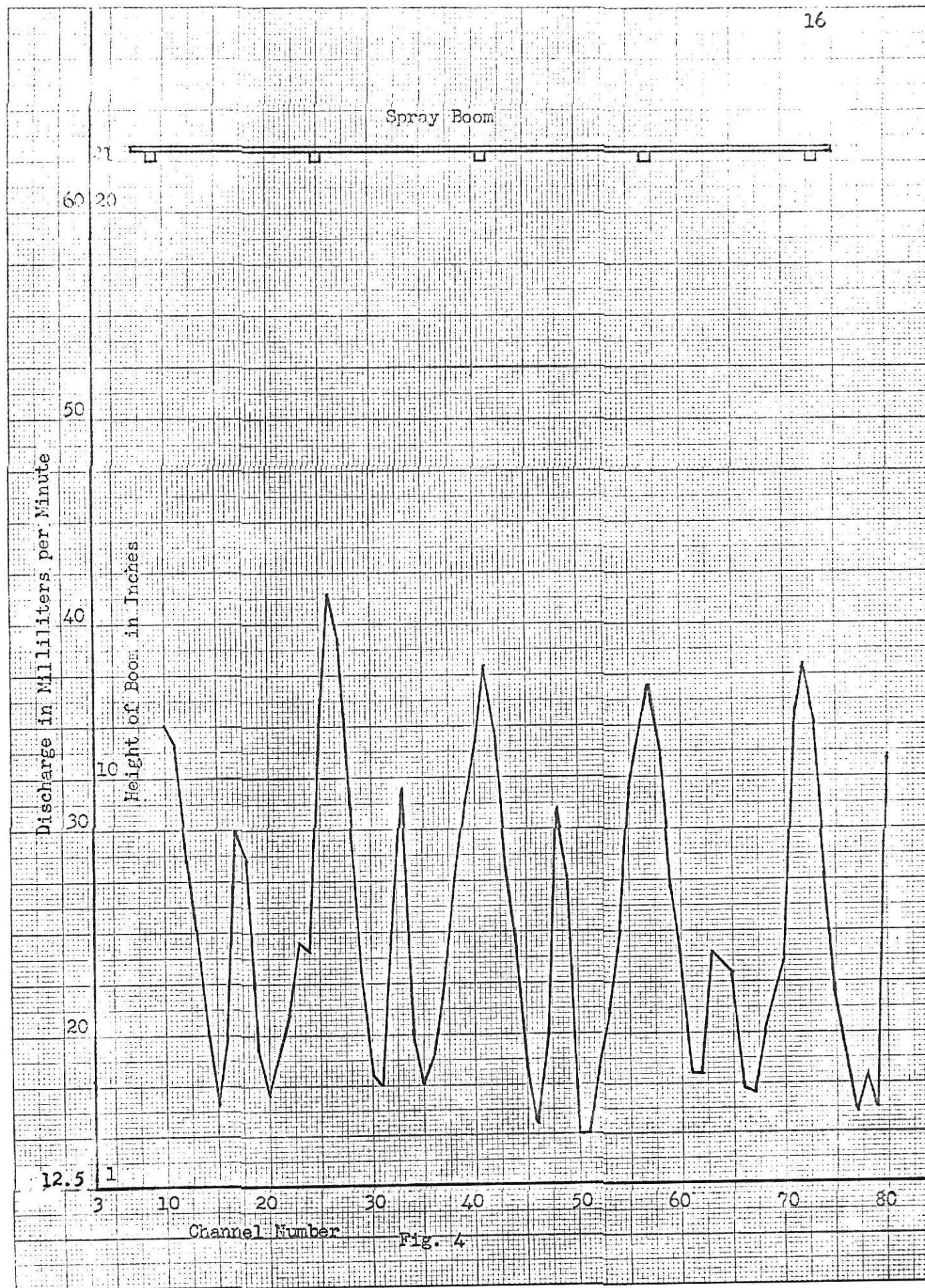
Flat Fan Type Nozzles No. 730154 with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 20 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches



Explanation of Fig. 5

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154 with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 25 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

Spray Boom

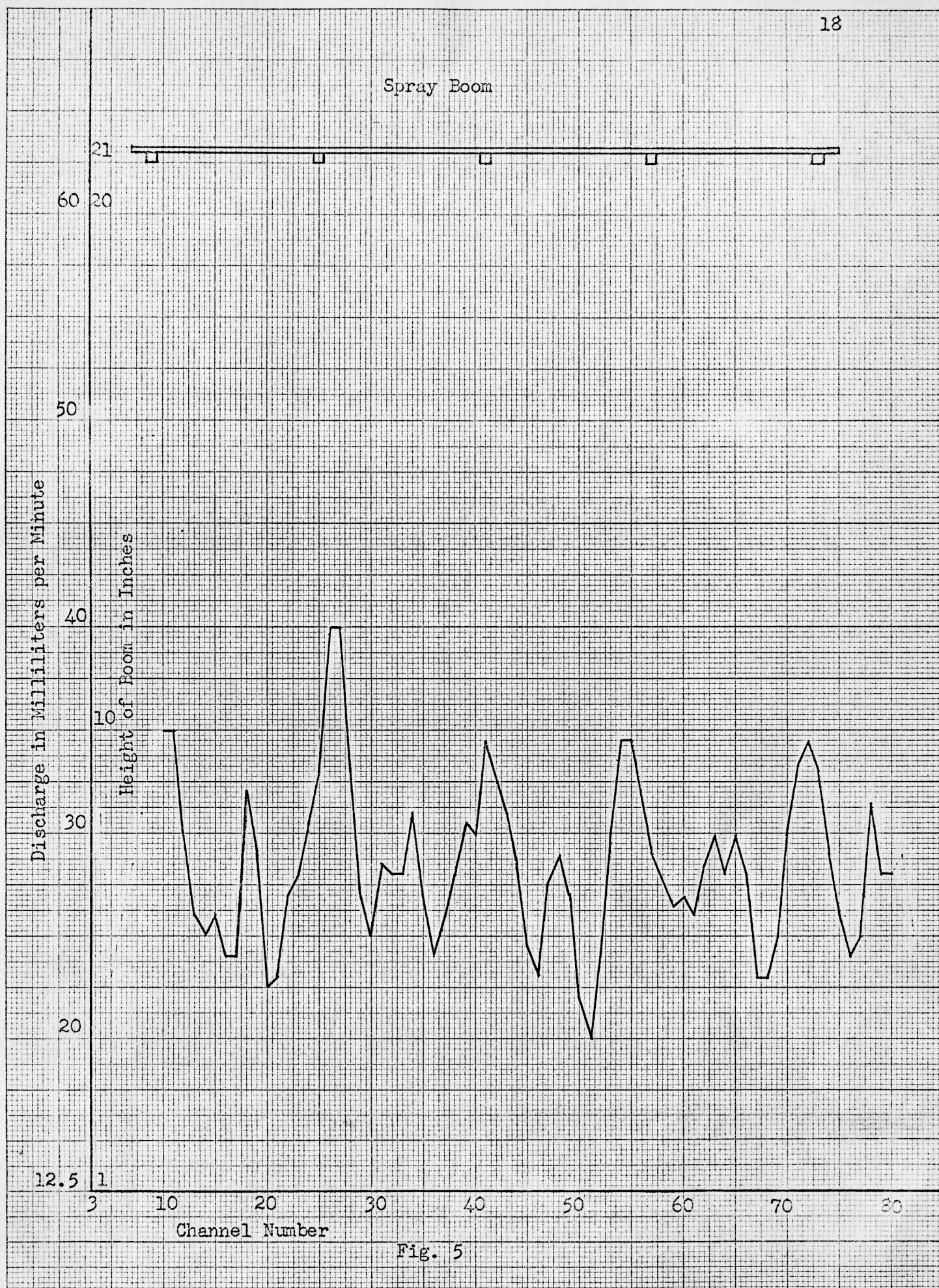


Fig. 5

Explanation of Fig. 6

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet

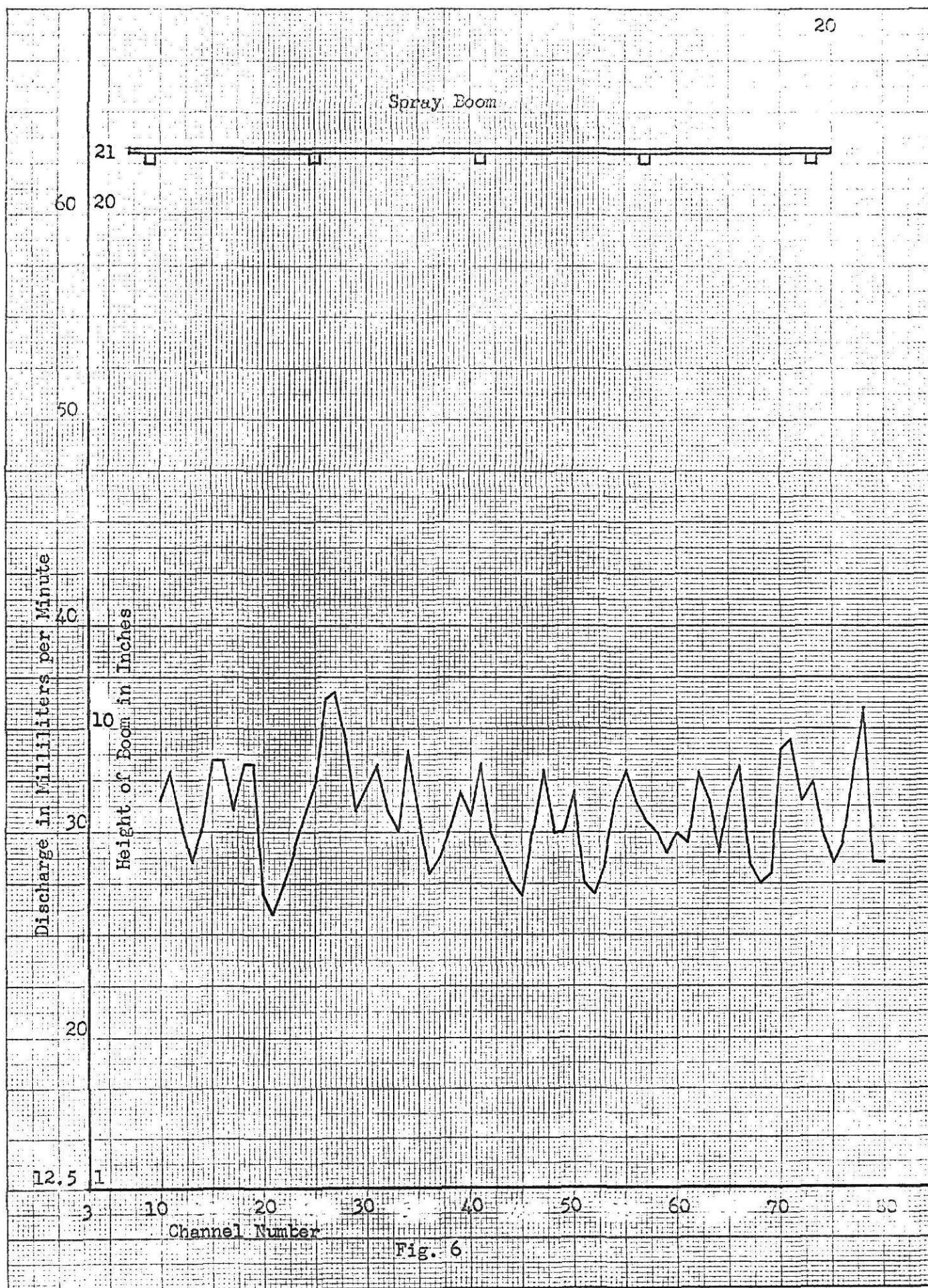
Flat Fan Type Nozzles No. 730154 with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches



Explanation of Fig. 7

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet

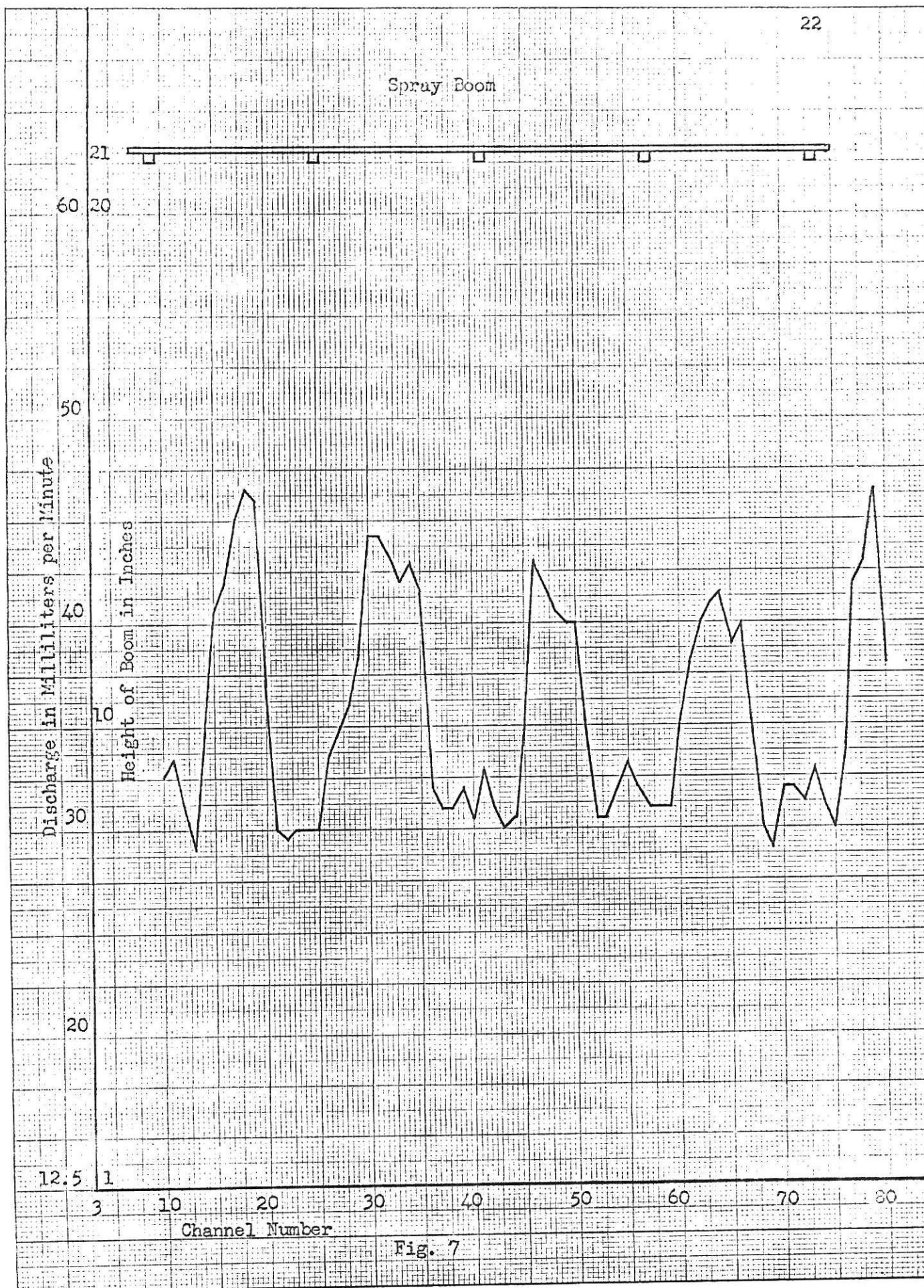
Flat Fan Type Nozzles No. 730154 with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 40 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches



Explanation of Fig. 8

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154 with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 50 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

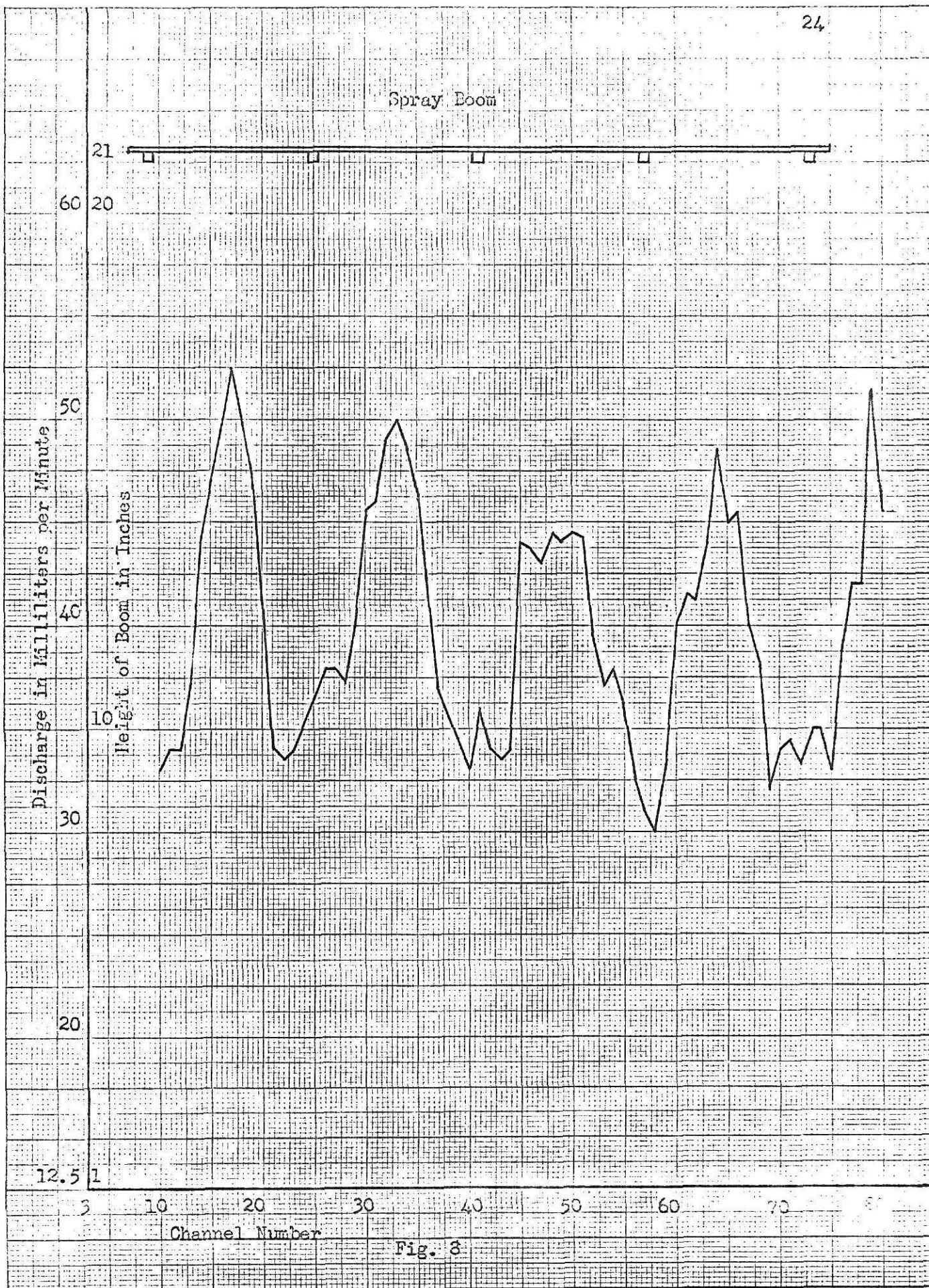


Fig. 3

Explanation of Fig. 9

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

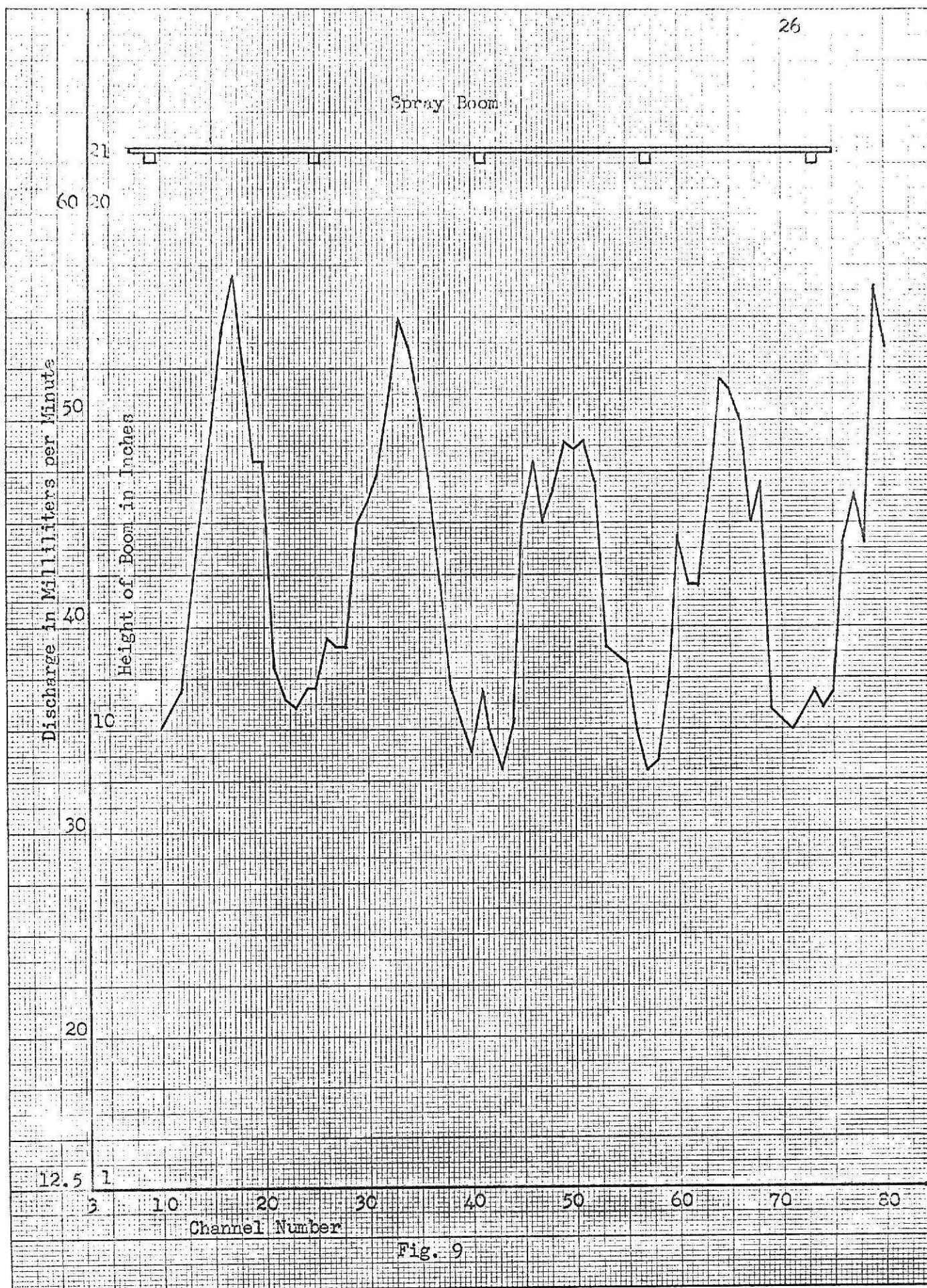


Fig. 9

Explanation of Fig. 10

Effect of Pressure Series Test

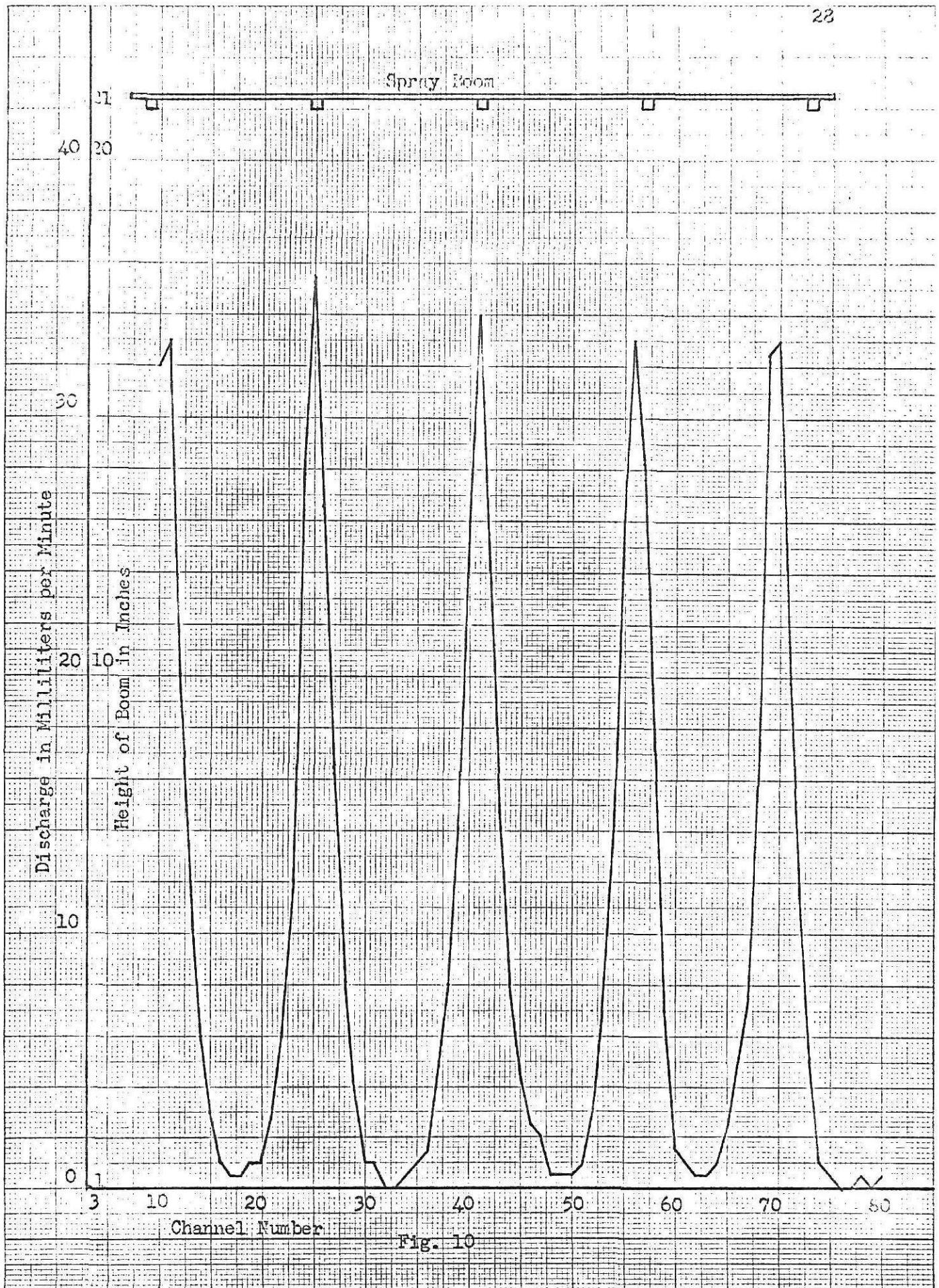
Distribution Pattern of Spraying Systems Tee Jet
Cone Style Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 20 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches



Explanation of Fig. 11

Effect of Pressure Series Test

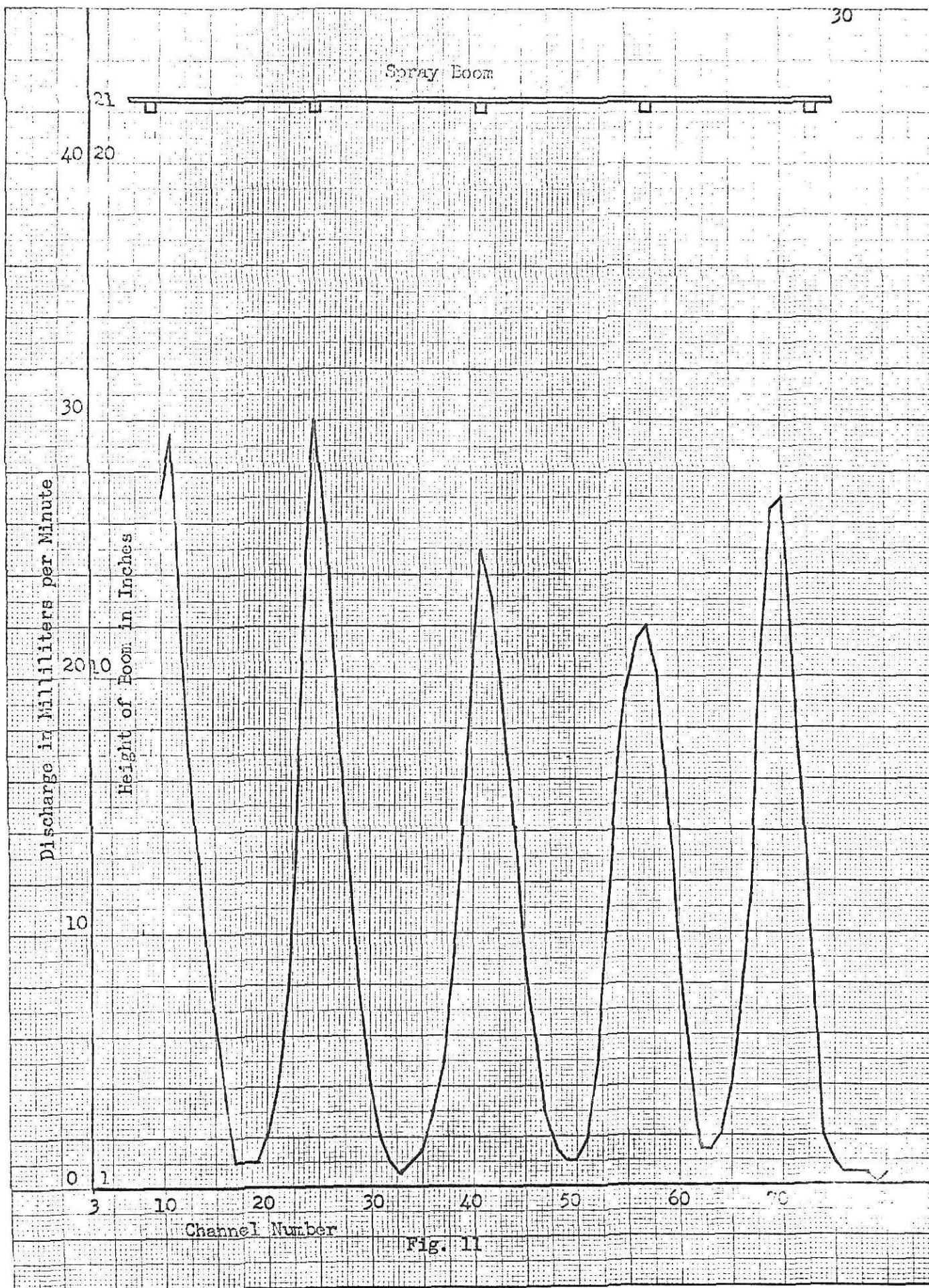
Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 25 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches



Explanation of Fig. 12

Effect of Pressure Series Test

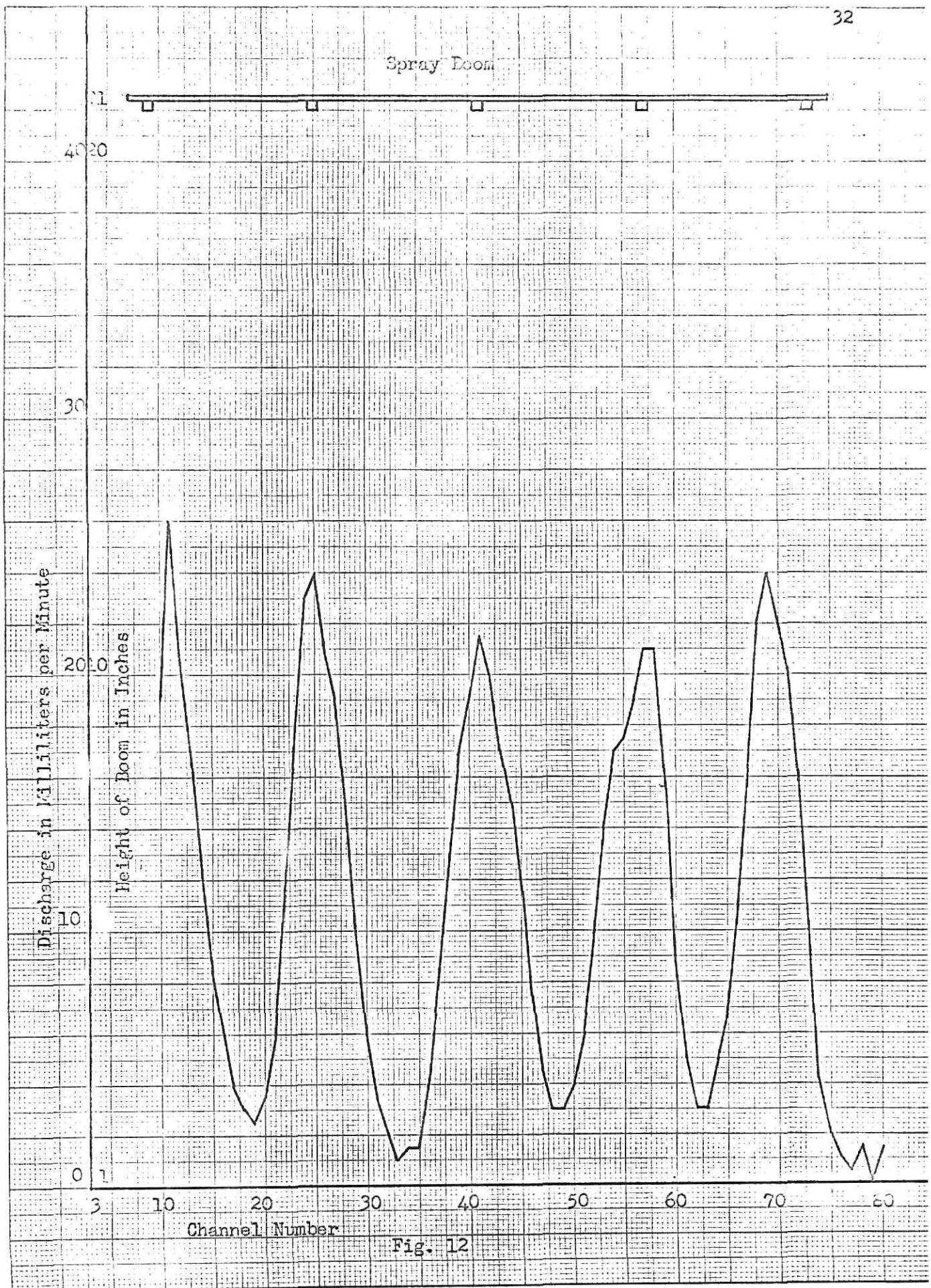
Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches



Explanation of Fig. 13

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 40 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

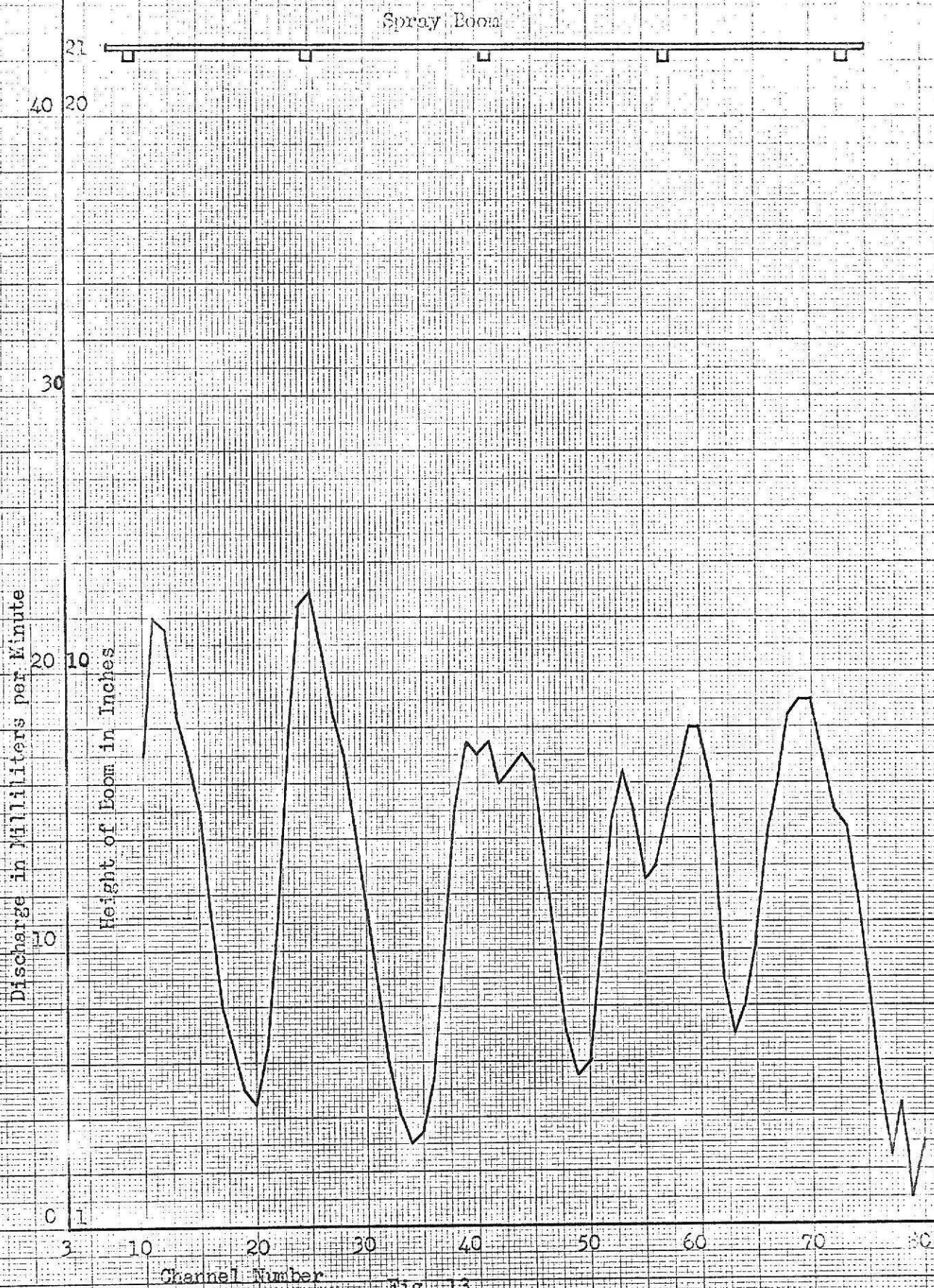


Fig. 13

Explanation of Fig. 14

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 50 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

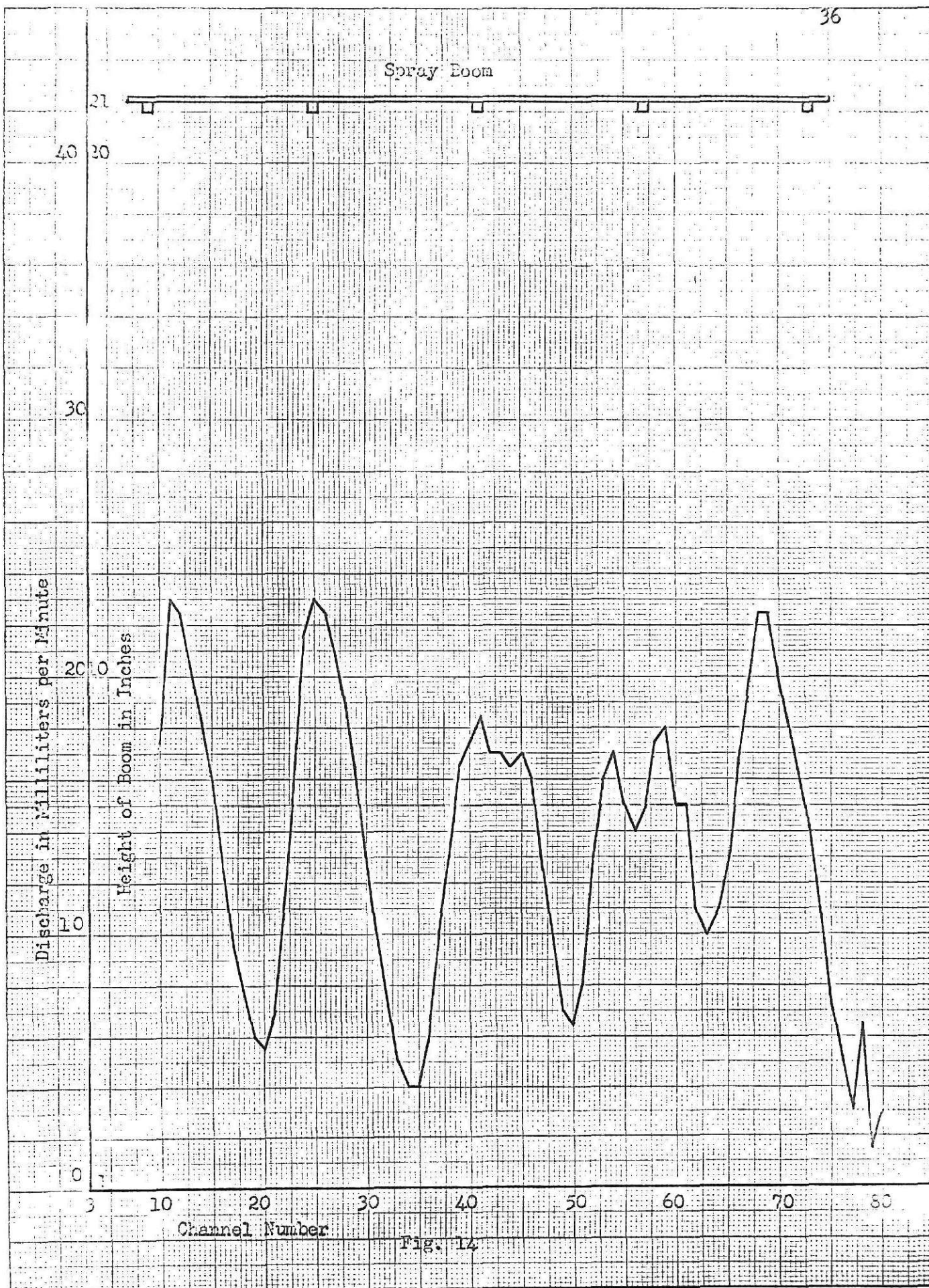


Fig. 14

Explanation of Fig. 15

Effect of Pressure Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi .

Nozzle spacing = 20 inches

Nozzle height = 21 inches

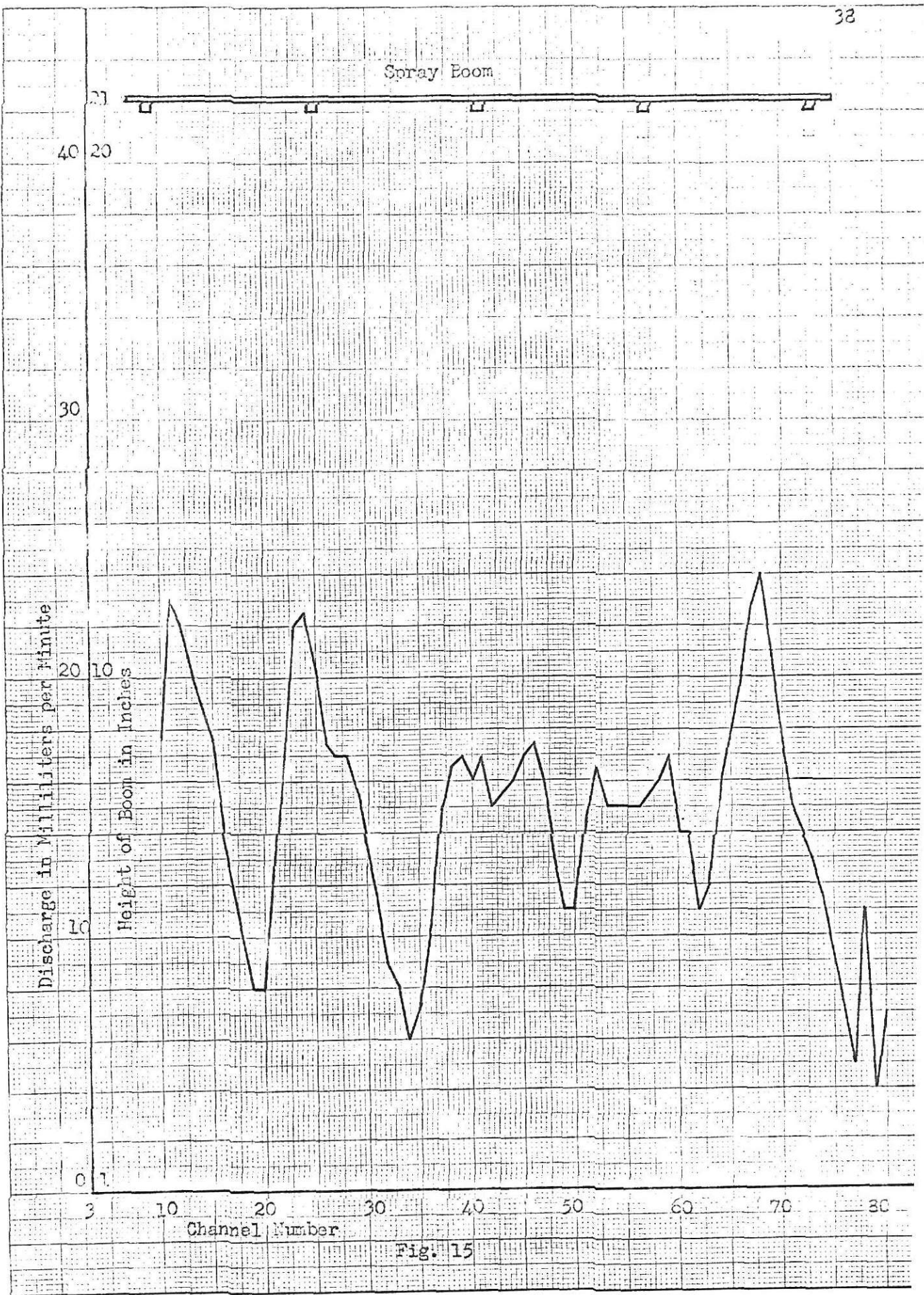


Fig. 15

Since uniformity of the distribution improved with each increase in pressure, it is quite probable that better spray patterns could have been obtained with pressure setting above the maximum of 60 psi used in this series of tests. It is interesting to note that the manufacturer rated this nozzle with a pressure setting of 75 psi.

Effect of Nozzle Spacing on the Distribution Pattern of the Flat Fan Type Nozzles

In this series of tests nozzle height was maintained at 21 inches and a pressure setting of 30 psi was used. Nozzle spacing was varied in two inch increments from 16 to 24 inches. The resulting spray patterns are shown in Fig. 16 through Fig. 20.

The 16 inch nozzle spacing gave complete double coverage. The resulting distribution pattern is shown in Fig. 16. It was evident that there was a considerable increase in application rate in the overlap zone between the nozzles. This effect was still evident at the 18 inch nozzle spacing as shown in Fig. 17. At the 20 inch nozzle spacing however, as shown in Fig. 18, the distribution pattern showed a greater rate of distribution directly under the nozzles. It will be remembered that this same set of conditions gave the most uniform rate of distribution in the pressure series of tests. Increased application was even more pronounced for the 22 and 24 inch nozzle spacing as shown in Fig. 19 and Fig. 20.

Effect of Nozzle Spacing on the Distribution Pattern of the Cone Type Nozzles

The cone type nozzles were subjected to the same set of conditions for checking the effect of nozzle spacing as were the fan type nozzles.

Explanation of Fig. 16.

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet

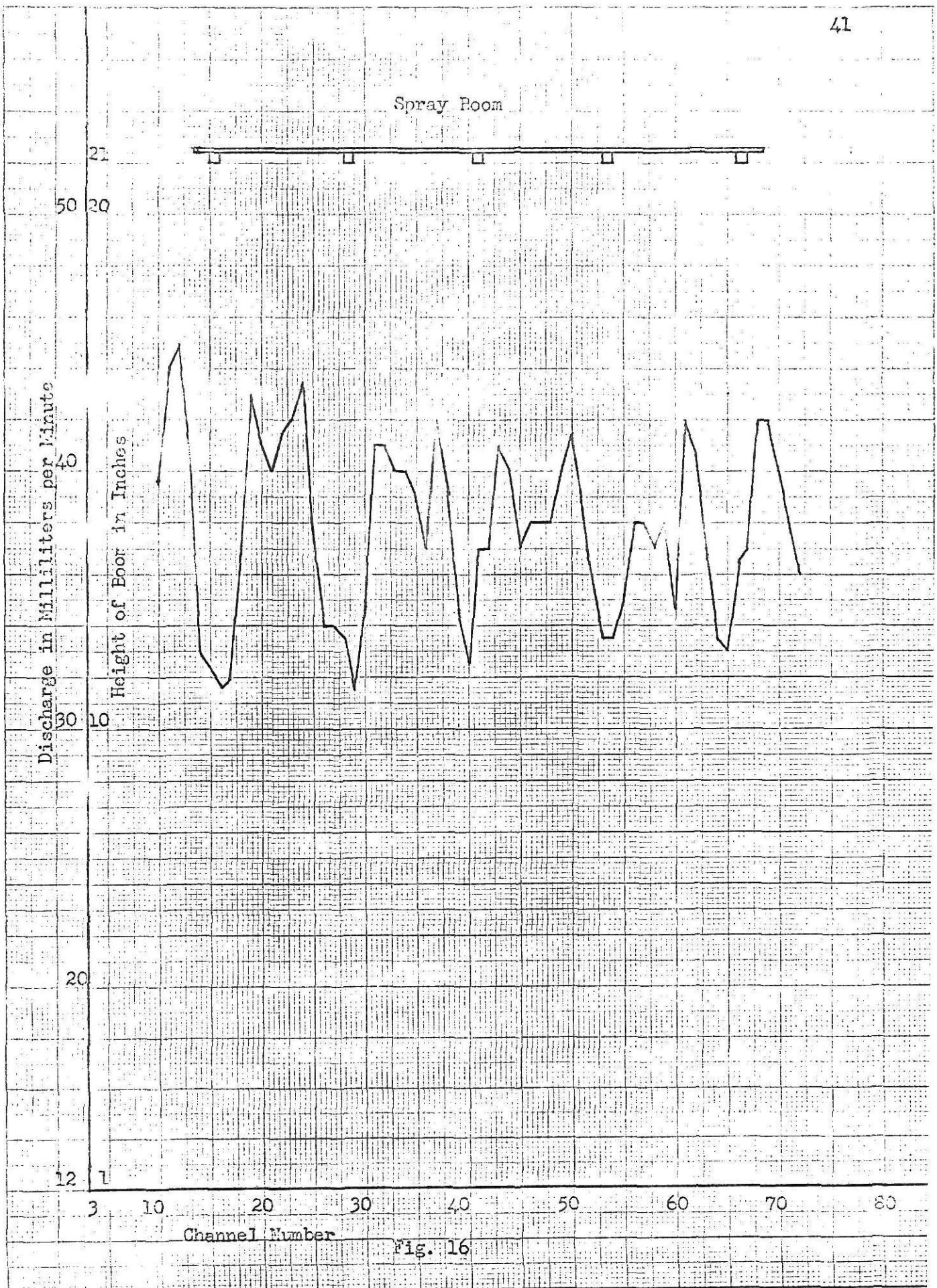
Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 16 inches

Nozzle height = 21 inches



Explanation of Fig. 17

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet

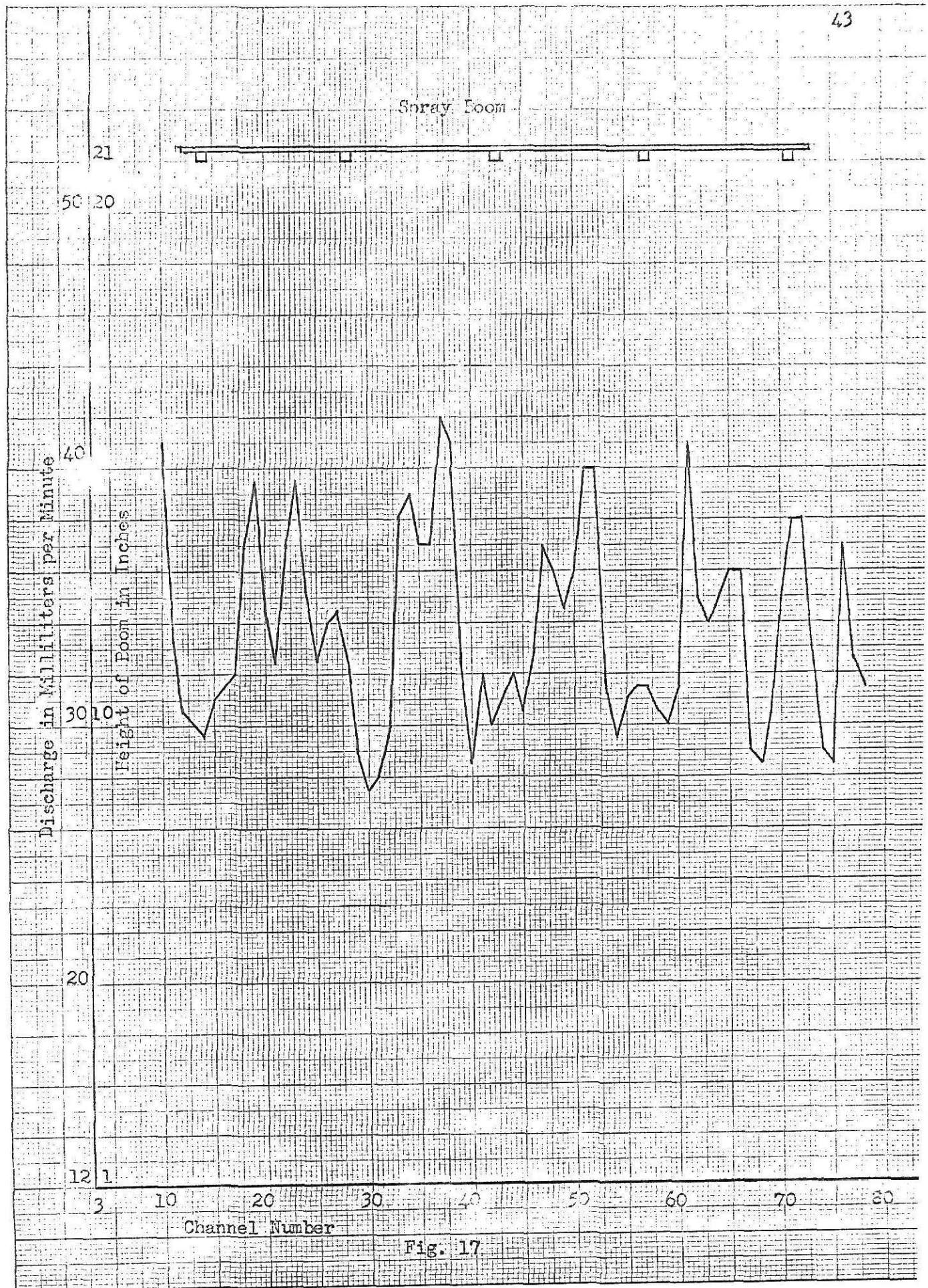
Flat Fan Type Noggles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 18 inches

Nozzle height = 21 inches



Explanation of Fig. 18

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

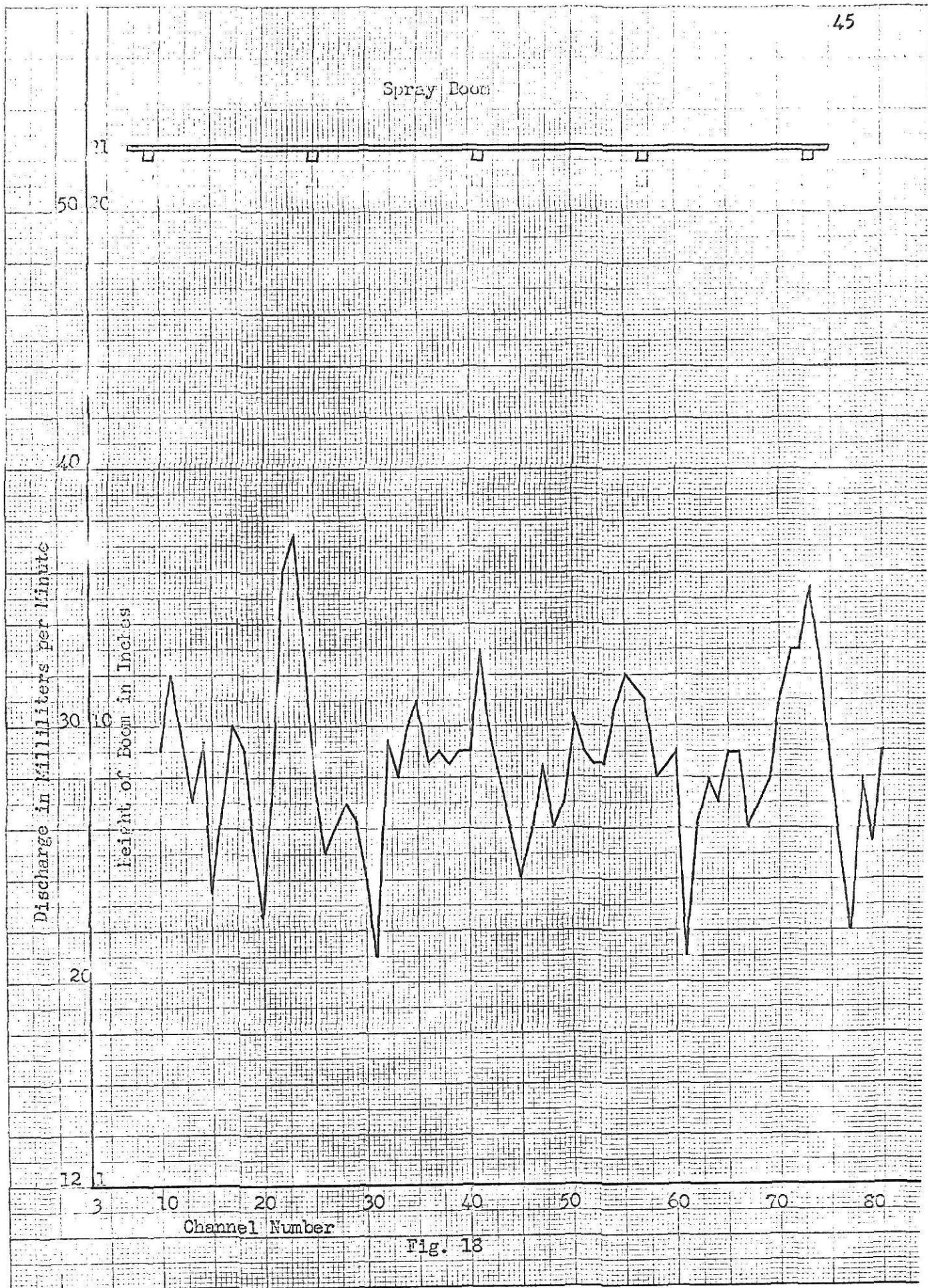


Fig. 18

Explanation of Fig. 19

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet

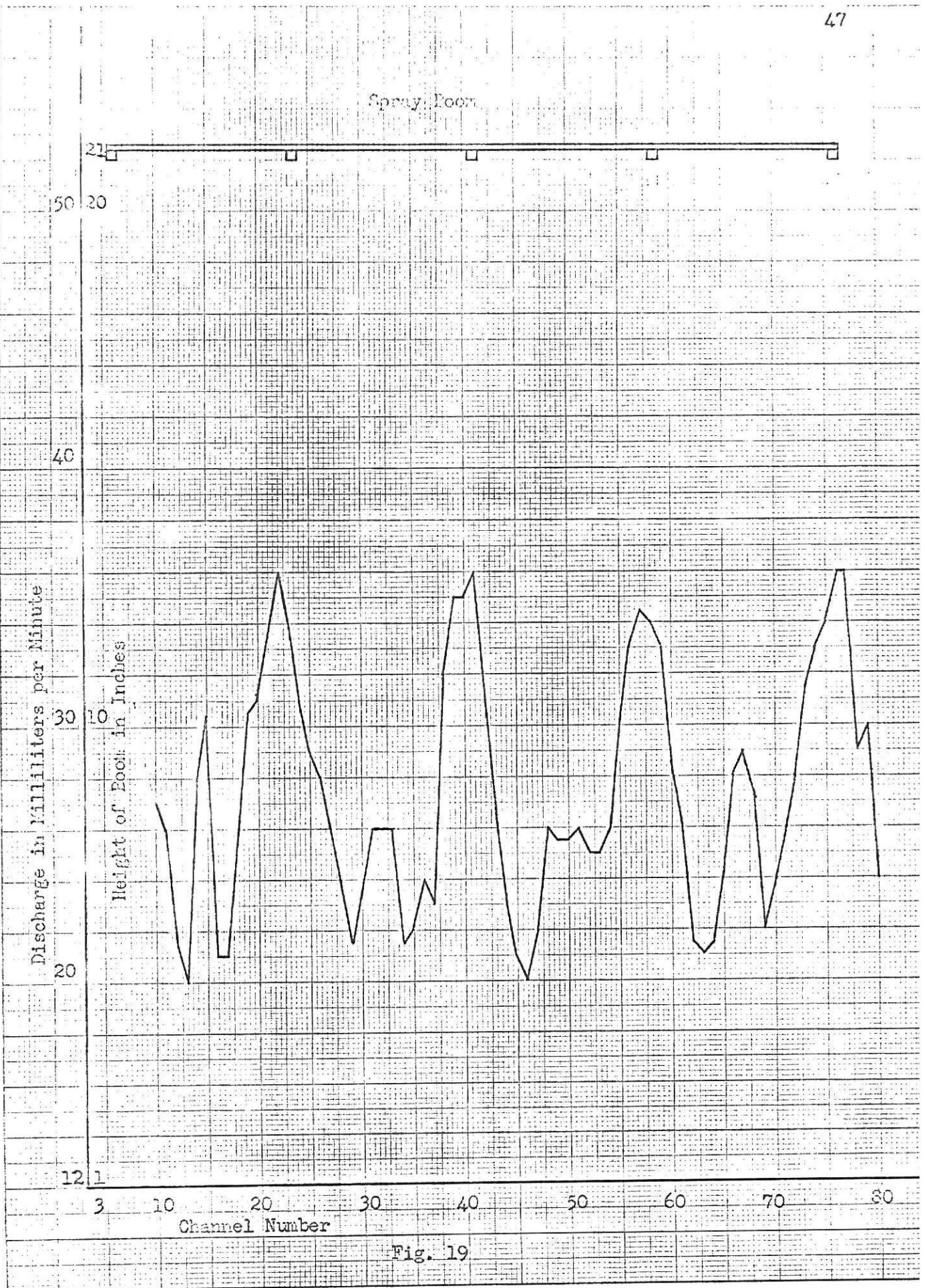
Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 22 inches

Nozzle height = 21 inches



Explanation of Fig. 20

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet

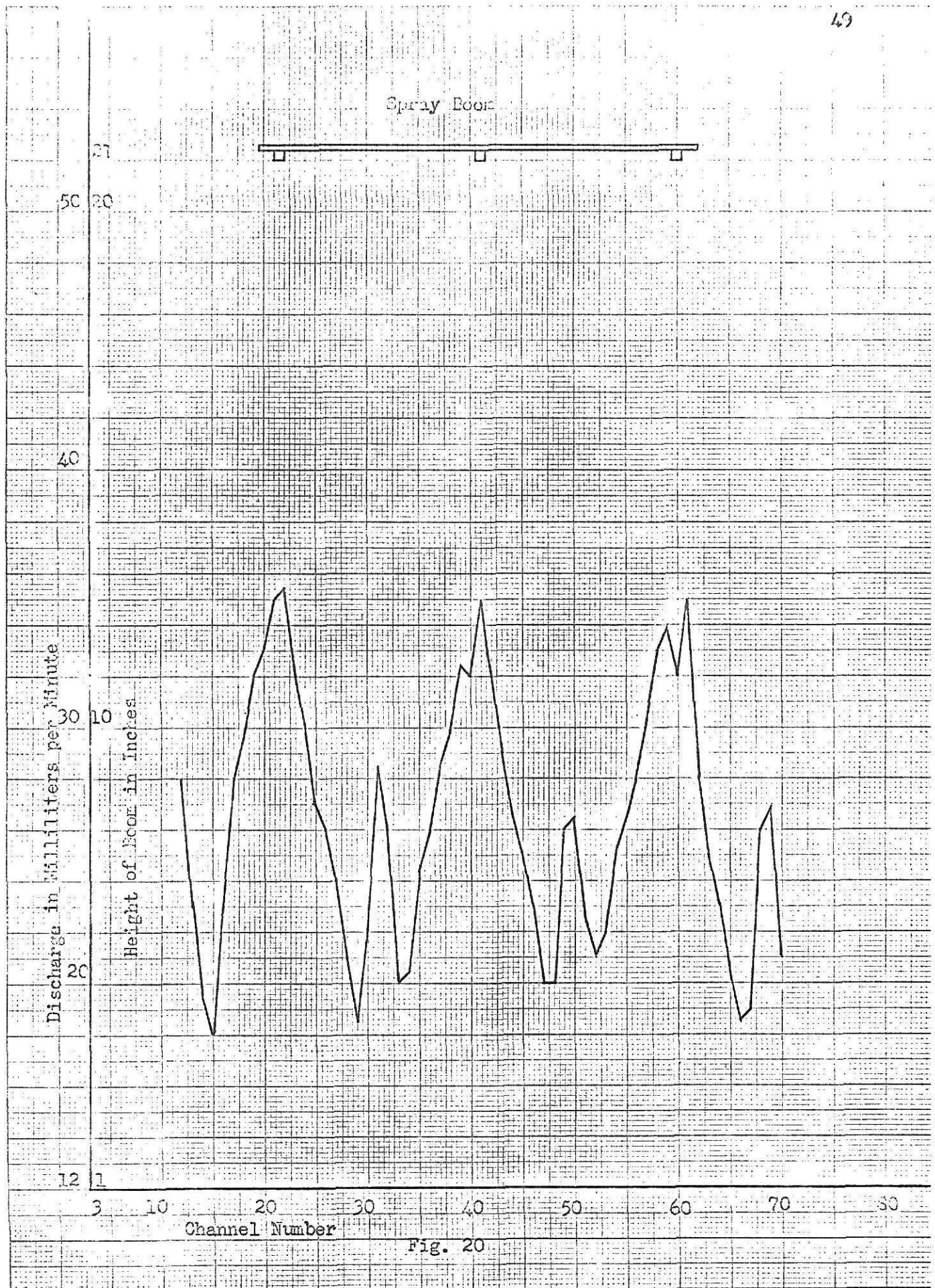
Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 24 inches

Nozzle height = 21 inches



The distribution patterns for this series of tests are shown in Fig. 21 through Fig. 25. In this series of tests the best distribution pattern was obtained with the 16 inch nozzle spacing as shown in Fig. 21. This pattern was not good and tended to show more spray application directly under the nozzles. As nozzle spacing was increased the build-up of application under the nozzles became more pronounced with each increased increment of width.

Effect of Nozzle Height on the Distribution Pattern for the Flat Fan Type Nozzles

A nozzle spacing of 20 inches and a pressure of 60 psi was used for this series of tests. The nozzle height was varied in 4 inch increments starting with a height of 17 inches. Fig. 26 shows the distribution pattern for 17 inch nozzle height and shows a heavy collection of spray in the overlap zone between the nozzles. Nozzle heights of 21, 25 and 29 inches gave progressively better distribution patterns as shown in Fig. 27, Fig. 28 and Fig. 29. At the 29 inch nozzle height, nozzles were giving complete double coverage and the overlap zone between the nozzles was still catching more of the nozzle discharge than the area directly under the nozzles.

Effect of the Nozzle Height on the Distribution Pattern for the Cone Type Nozzles

Fig. 30 through Fig. 33 show the results of this series of tests for the effect of nozzle height in the same manner as were the fan type nozzles. At the 17 and 21 inch nozzle heights the area directly under the nozzles received the heaviest application as shown in Fig. 30 and Fig. 31. For nozzle heights of 25 and 29 inches good distribution patterns were

Explanation of Fig. 21

Effect of Nozzle Spacing Series Test

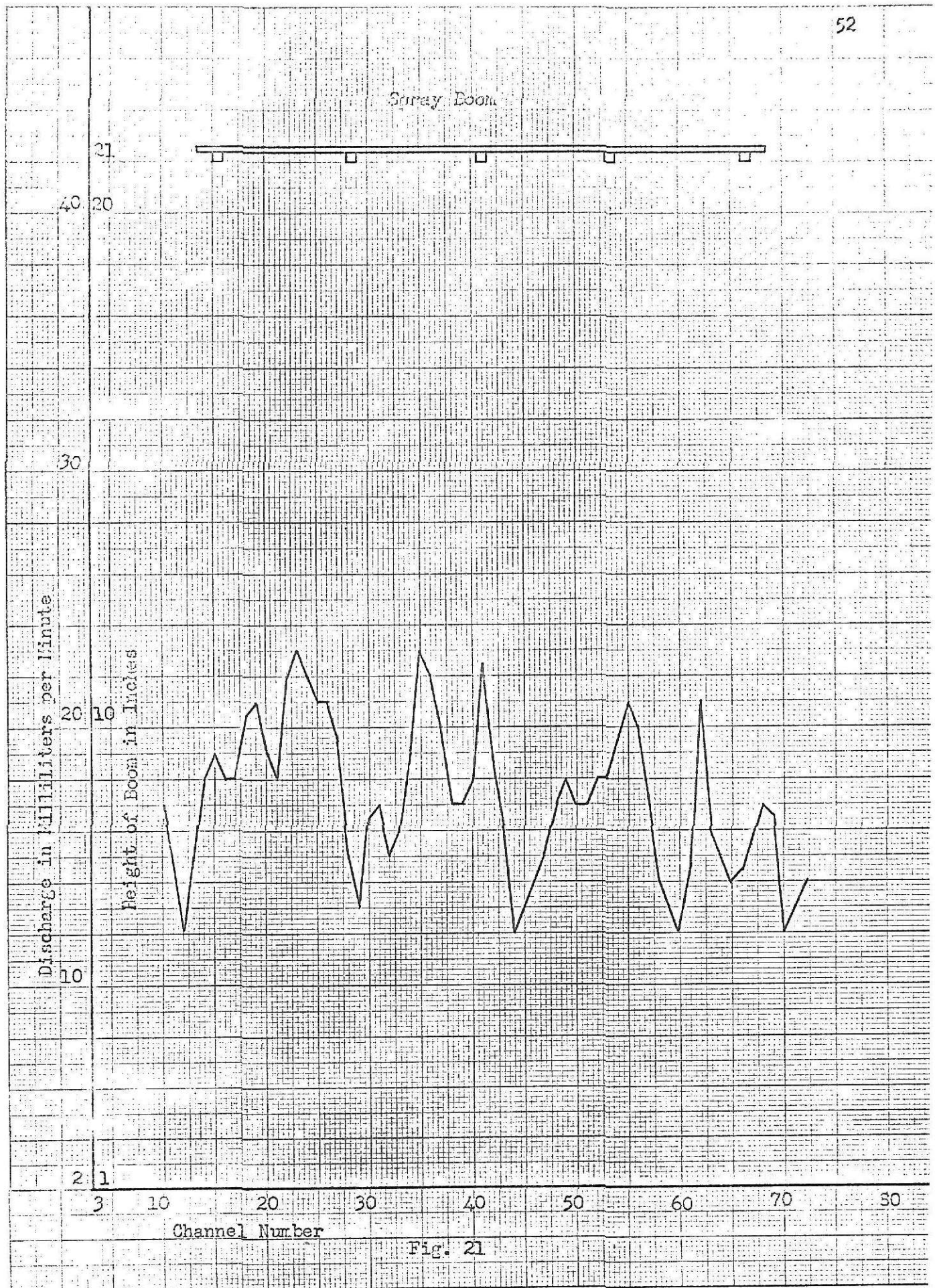
Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 16 inches

Nozzle height = 21 inches



Explanation of Fig. 22

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 18 inches

Nozzle height = 21 inches

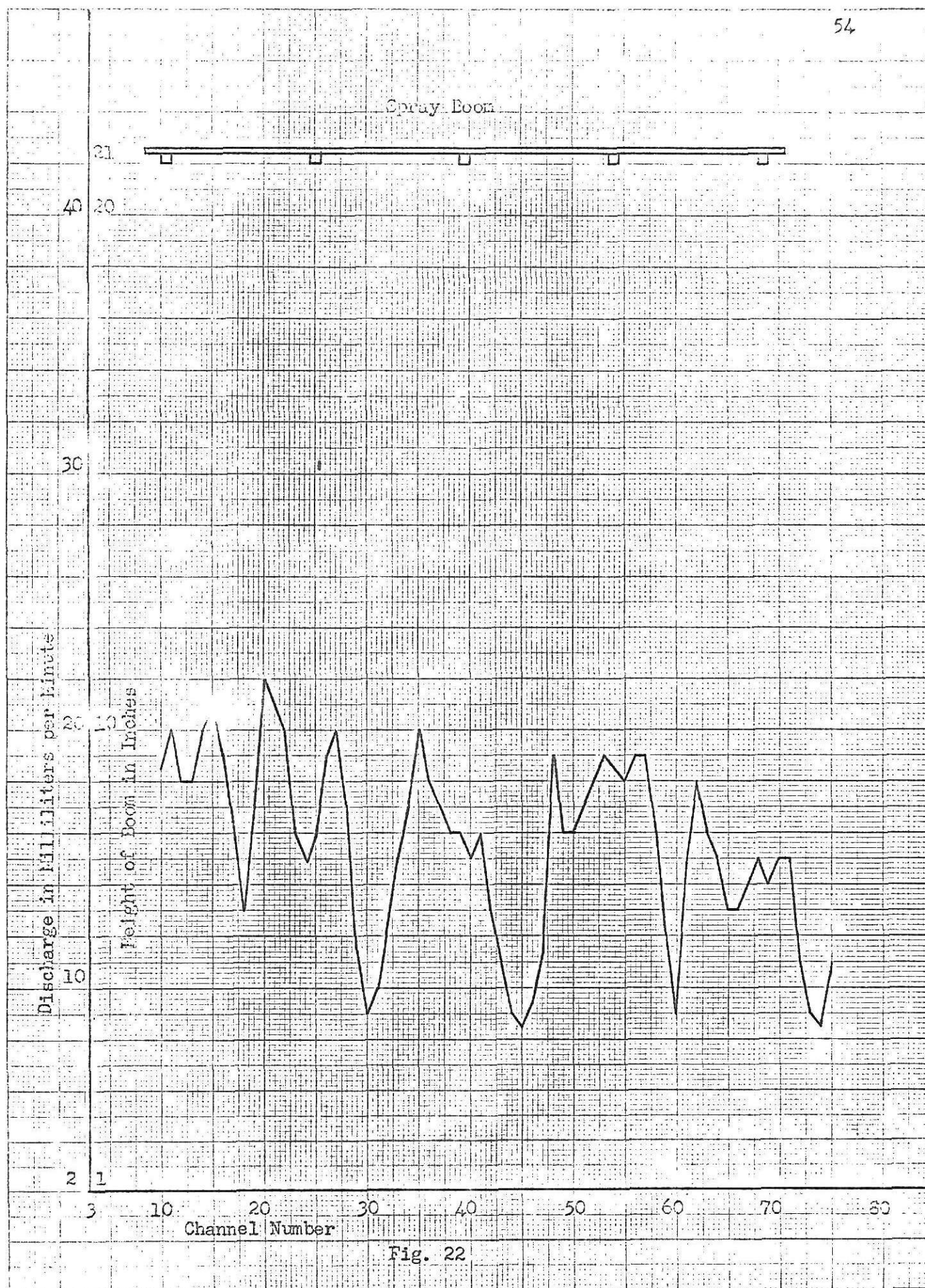


Fig. 22

Explanation of Fig. 23

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

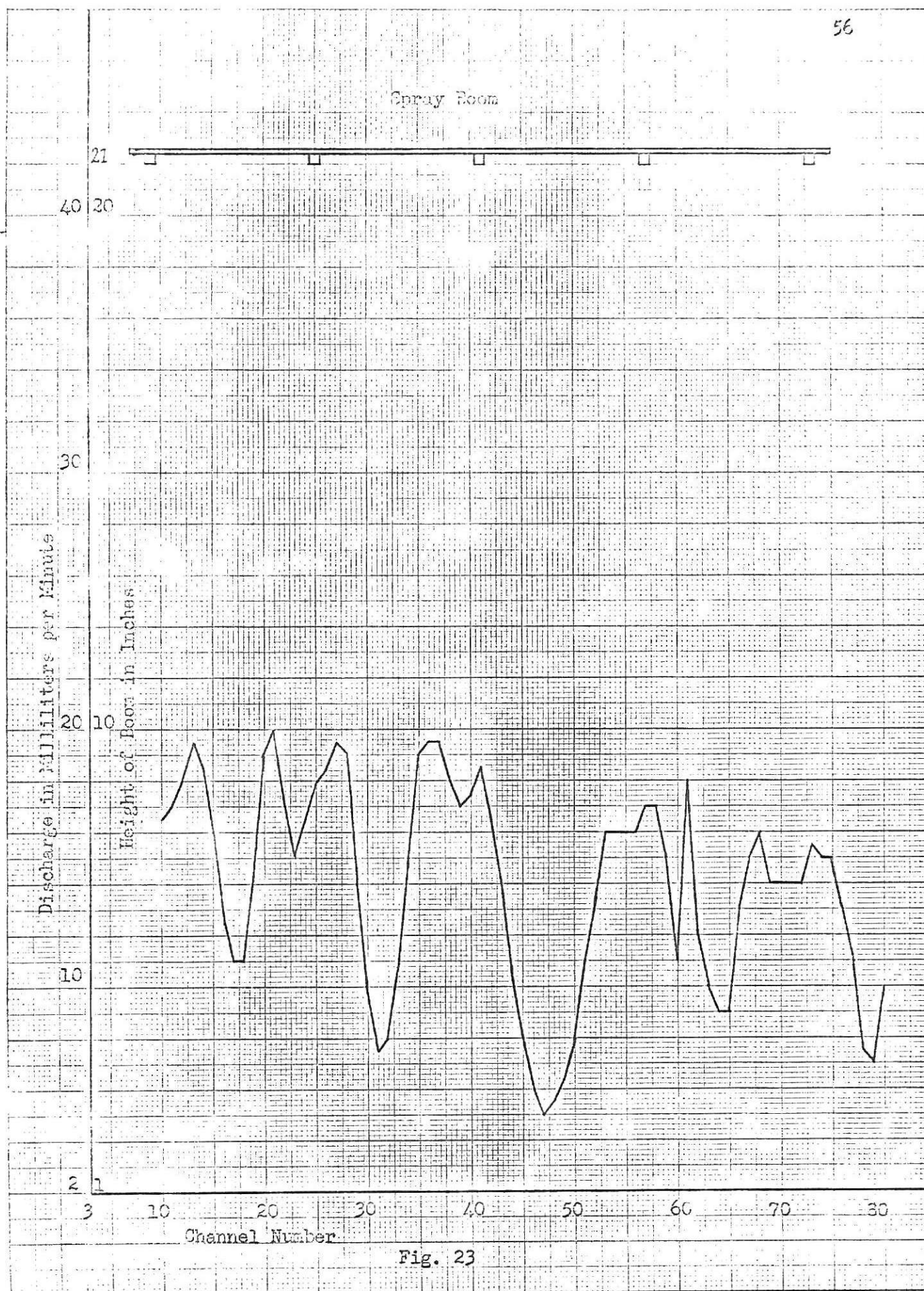


Fig. 23

Explanation of Fig. 24

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 22 inches

Nozzle height = 21 inches

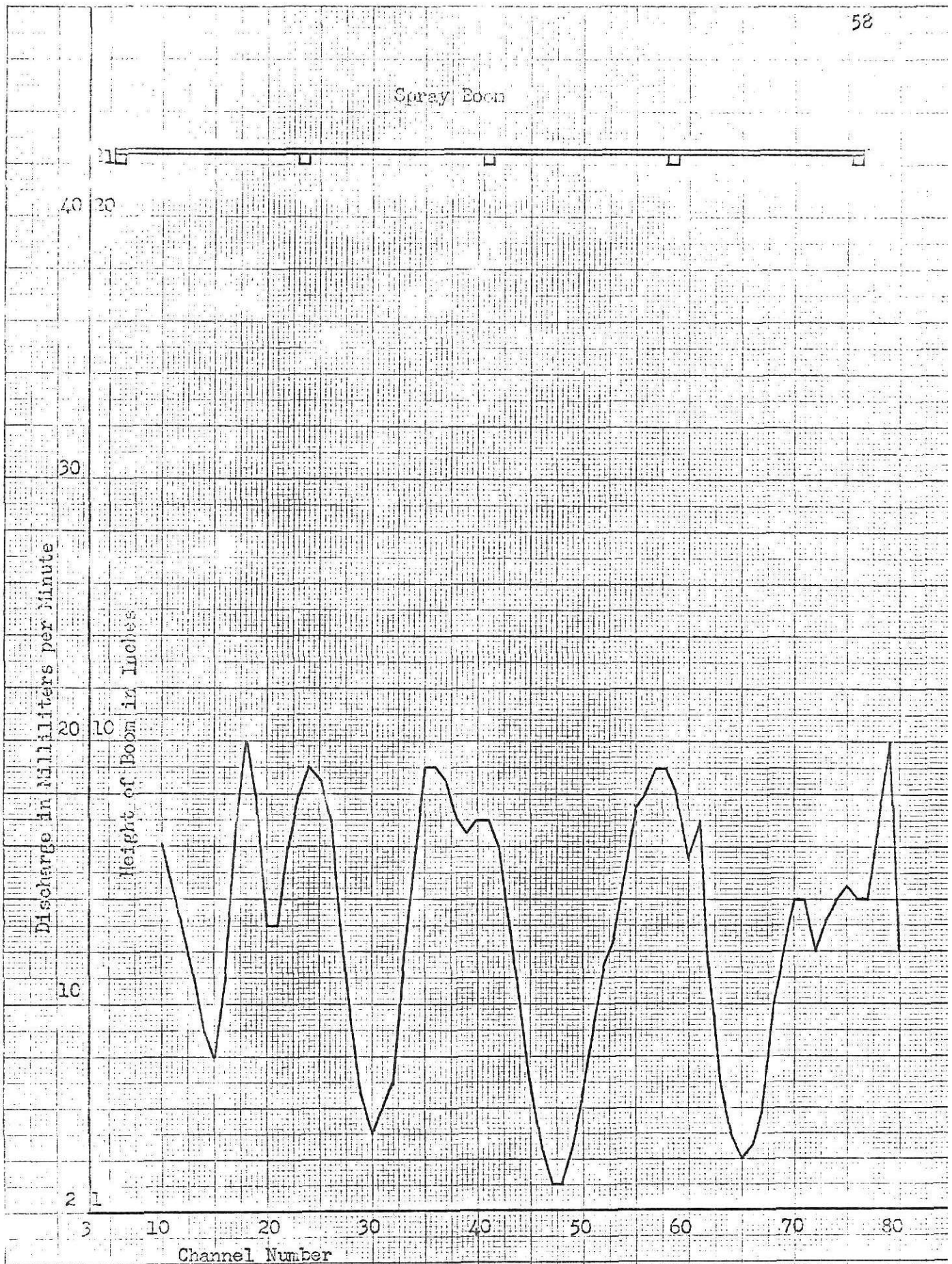


Fig. 24

Explanation of Fig. 25

Effect of Nozzle Spacing Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 30 psi

Nozzle spacing = 24 inches

Nozzle height = 21 inches

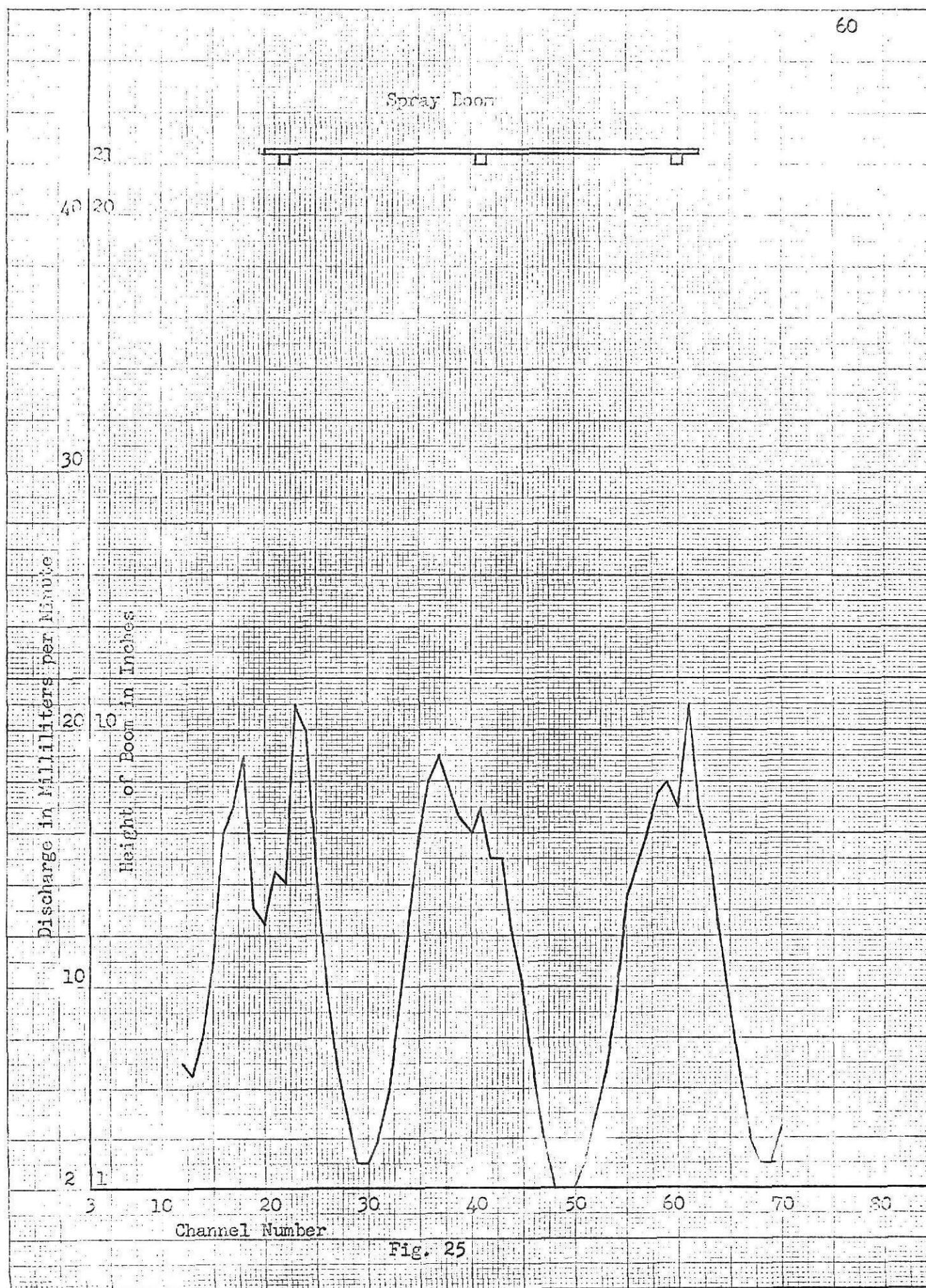


Fig. 25

Explanation of Fig. 26

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154, with 100 mesh screens,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 17 inches

Spray Room

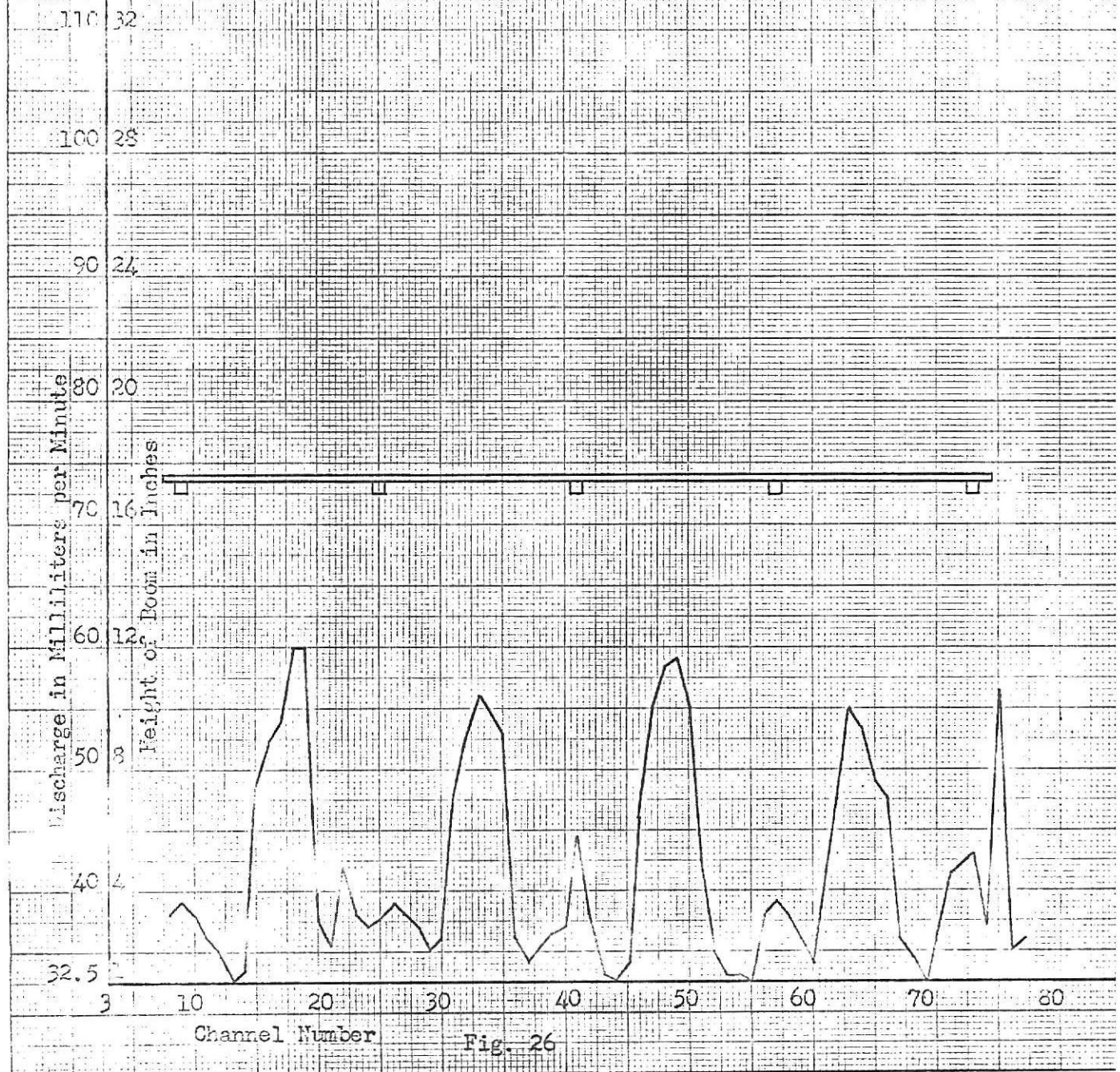


Fig. 26

Explanation of Fig. 27

Effect of Nozzle Height Series Test

Distribution Patterns of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

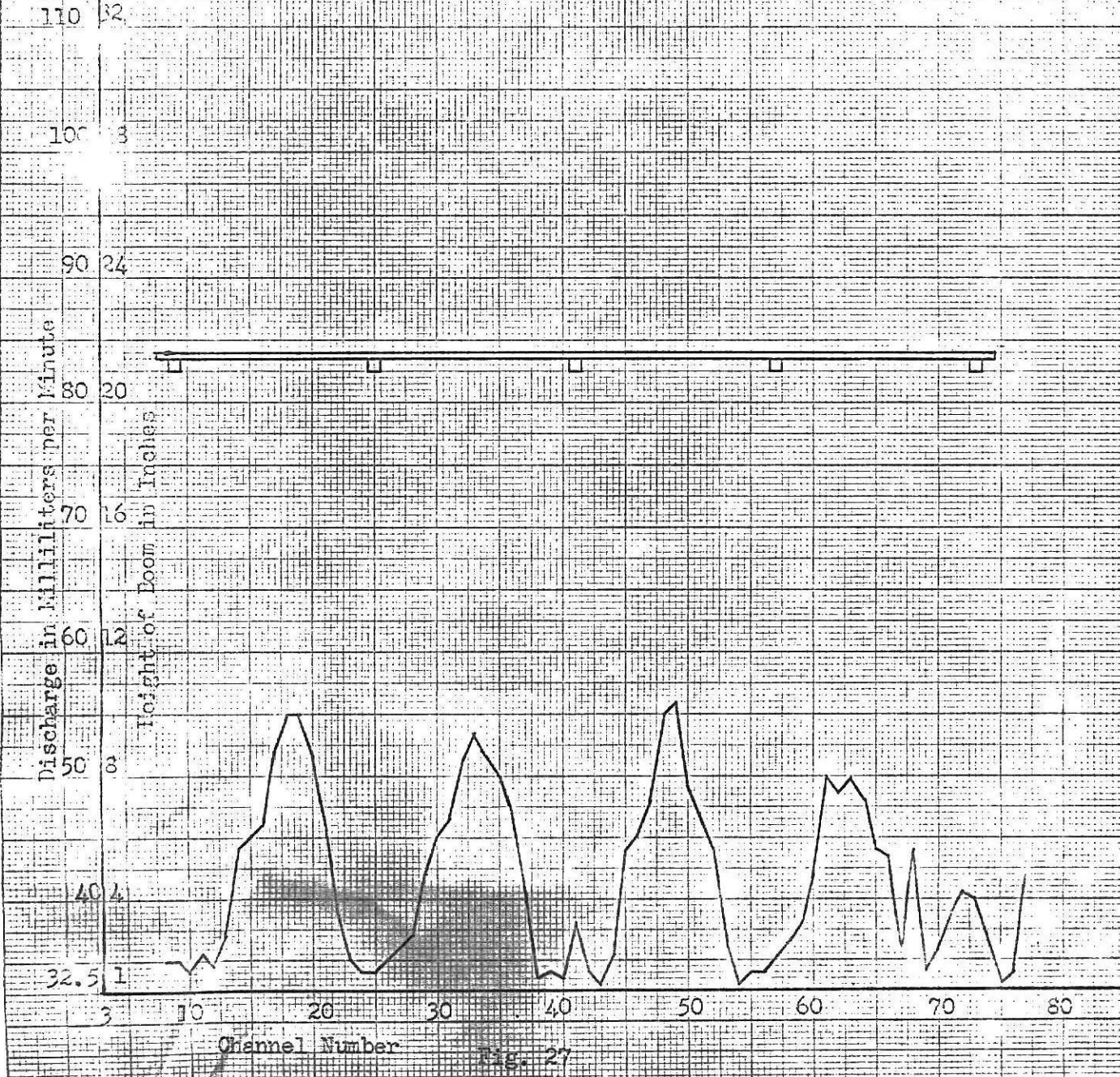
Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 21 inches

Spray Area



Channel Number

Fig. 27

Explanation of Fig. 28

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 25 inches

Spray Boom

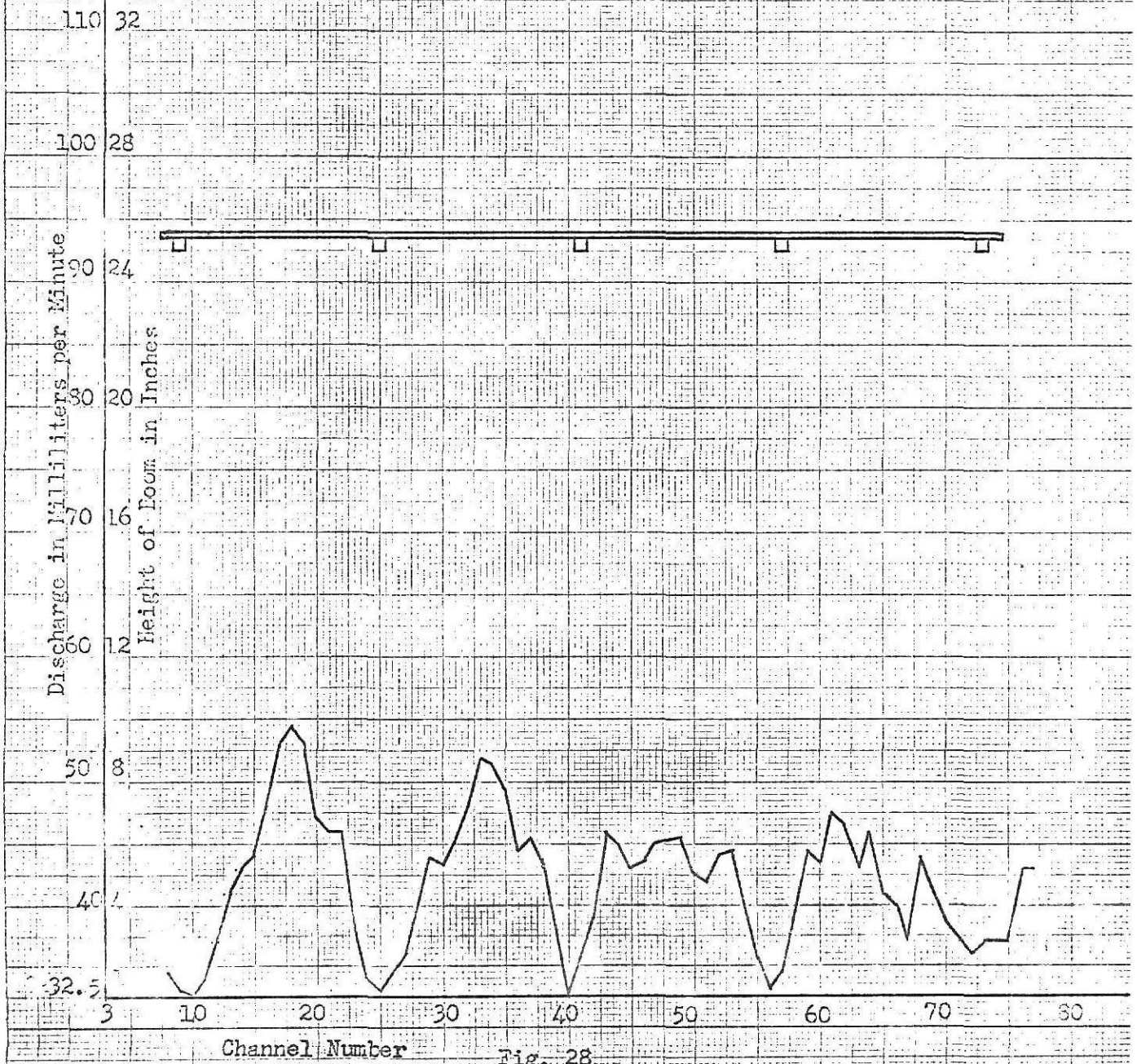


Fig. 28

Explanation of Fig. 29

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet

Flat Fan Type Nozzles No. 730154, with 100 mesh screen,
rated at 10 GPA at 30 psi pressure and ground speed
of 4 mph.

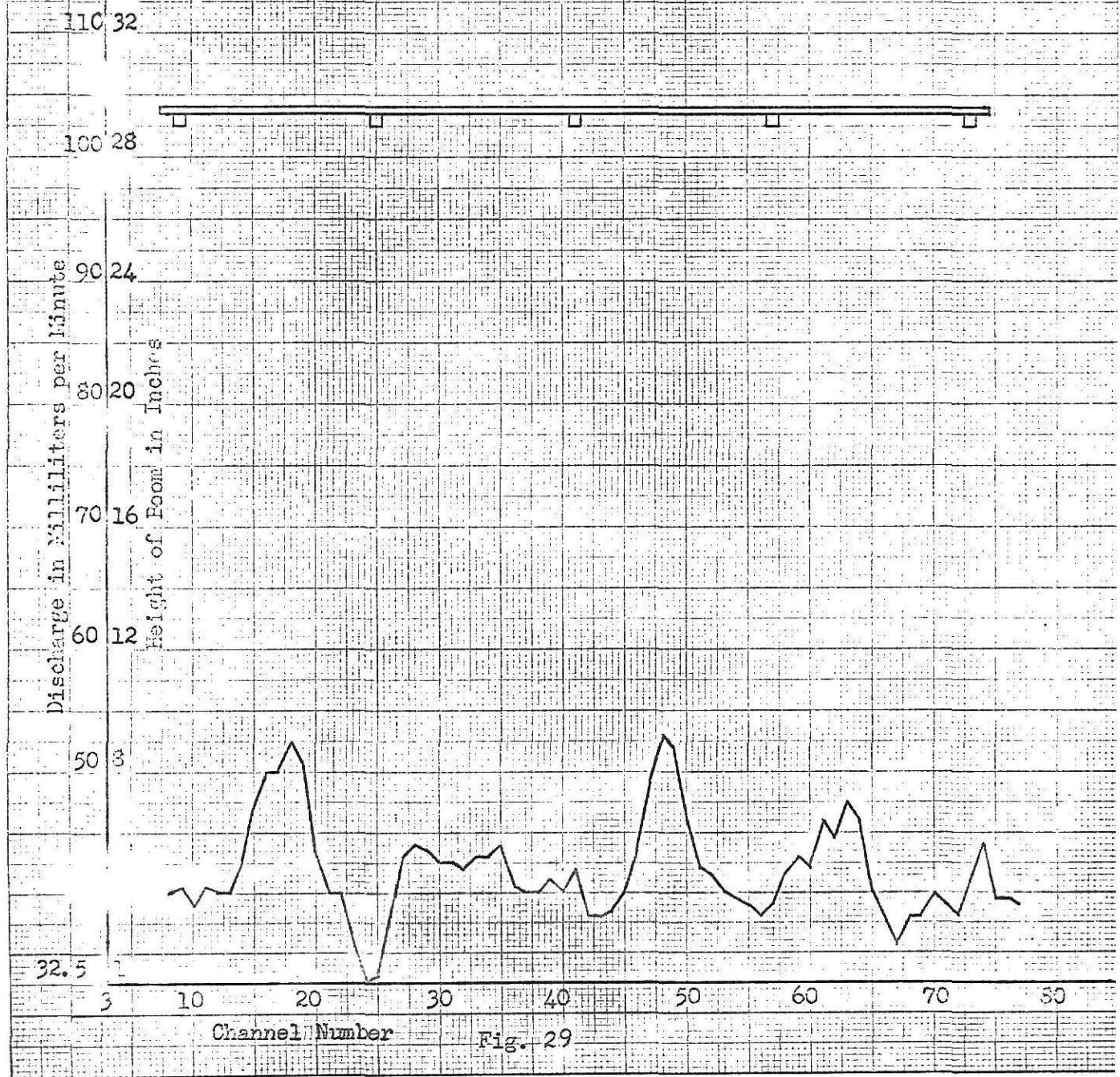
Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 29 inches

Spray Boom



Channel Number

Fig. 29

Explanation of Fig. 30

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground
speed of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 17 inches

Spray Boom

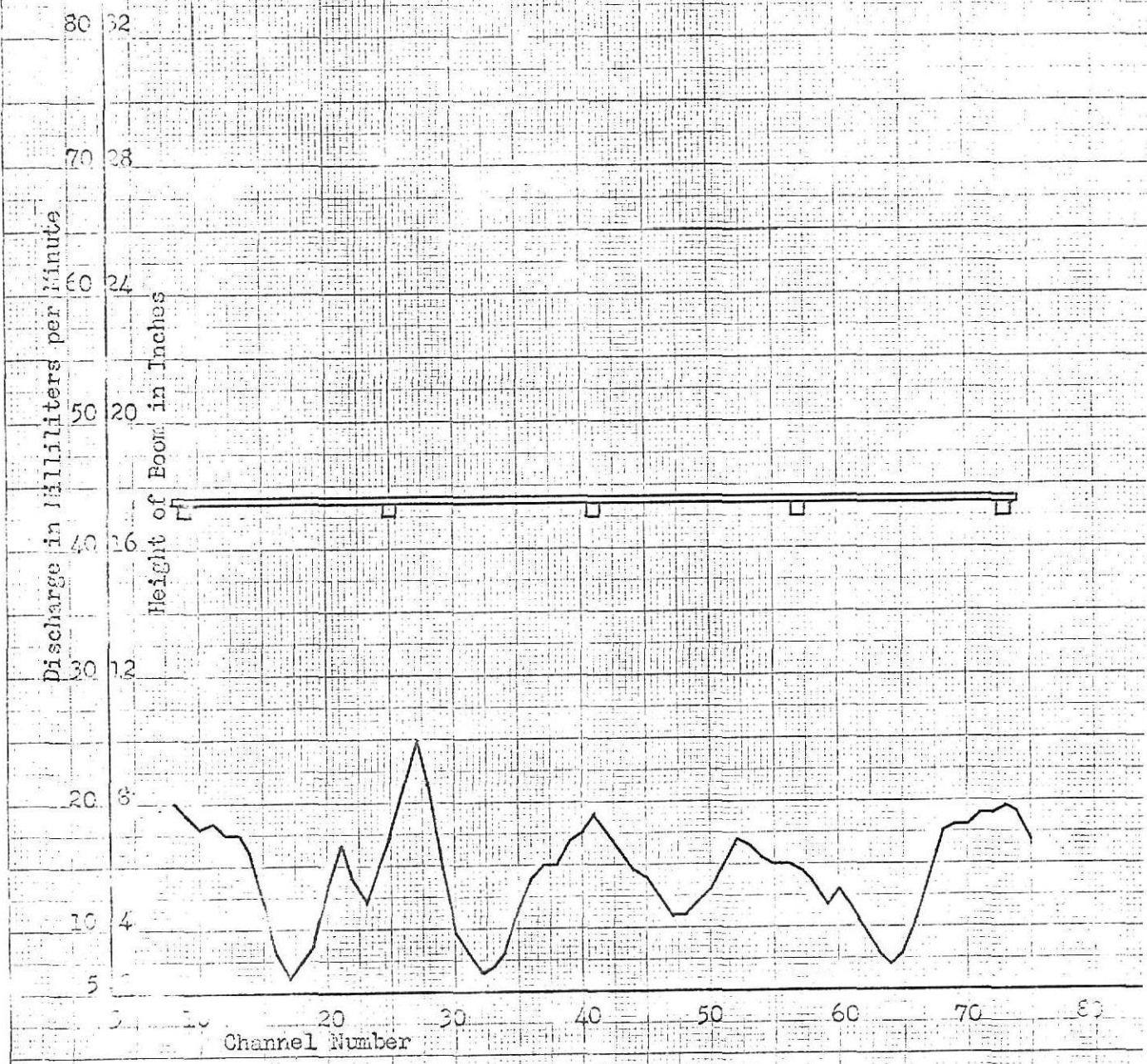


Fig. 30

Explanation of Fig. 31

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground
speed of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi
Nozzle spacing = 20 inches
Nozzle height = 21 inches

Spray Boom

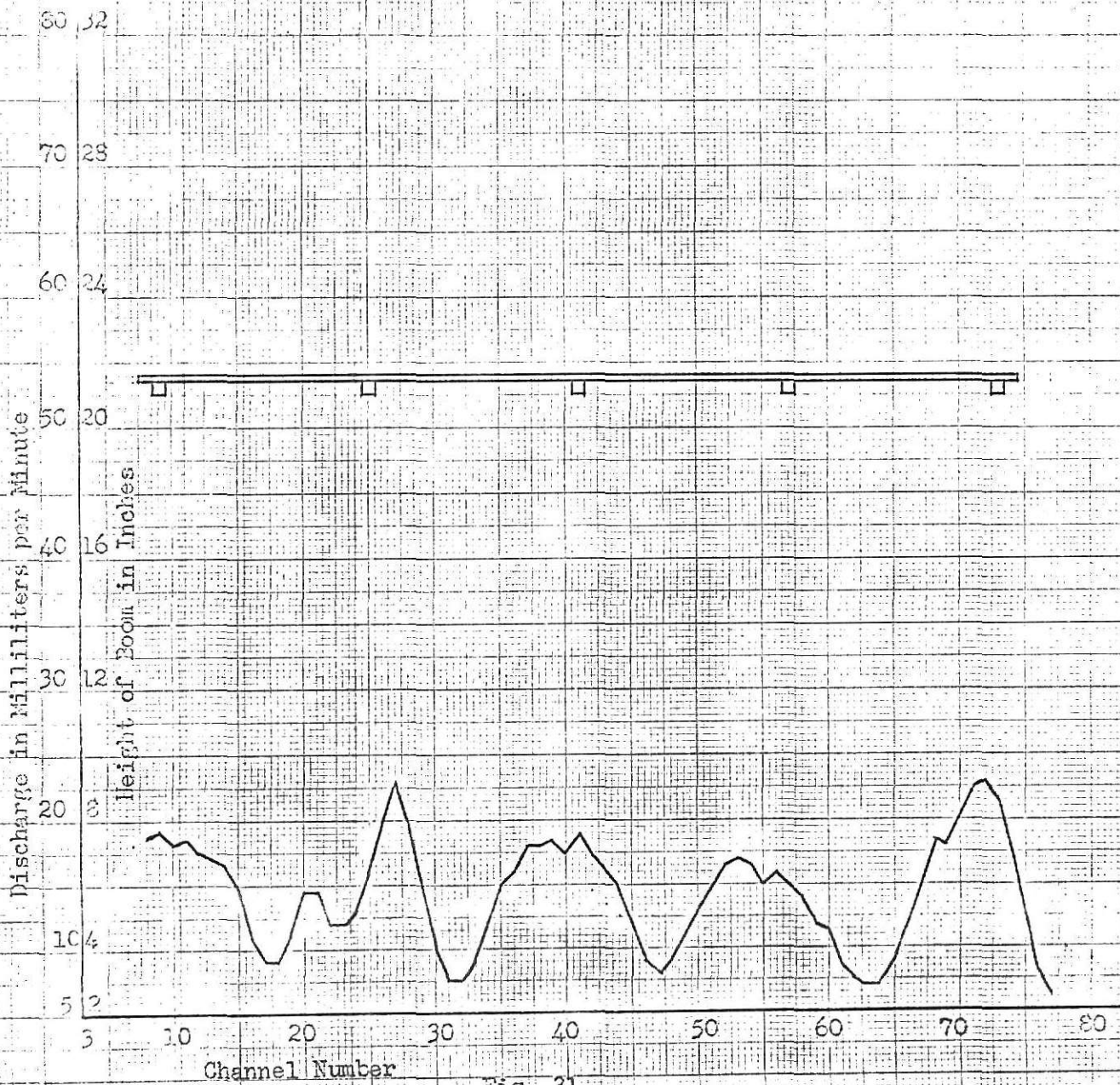


Fig. 31

Explanation of Fig. 32

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground
speed of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 25 inches

Spray Boom

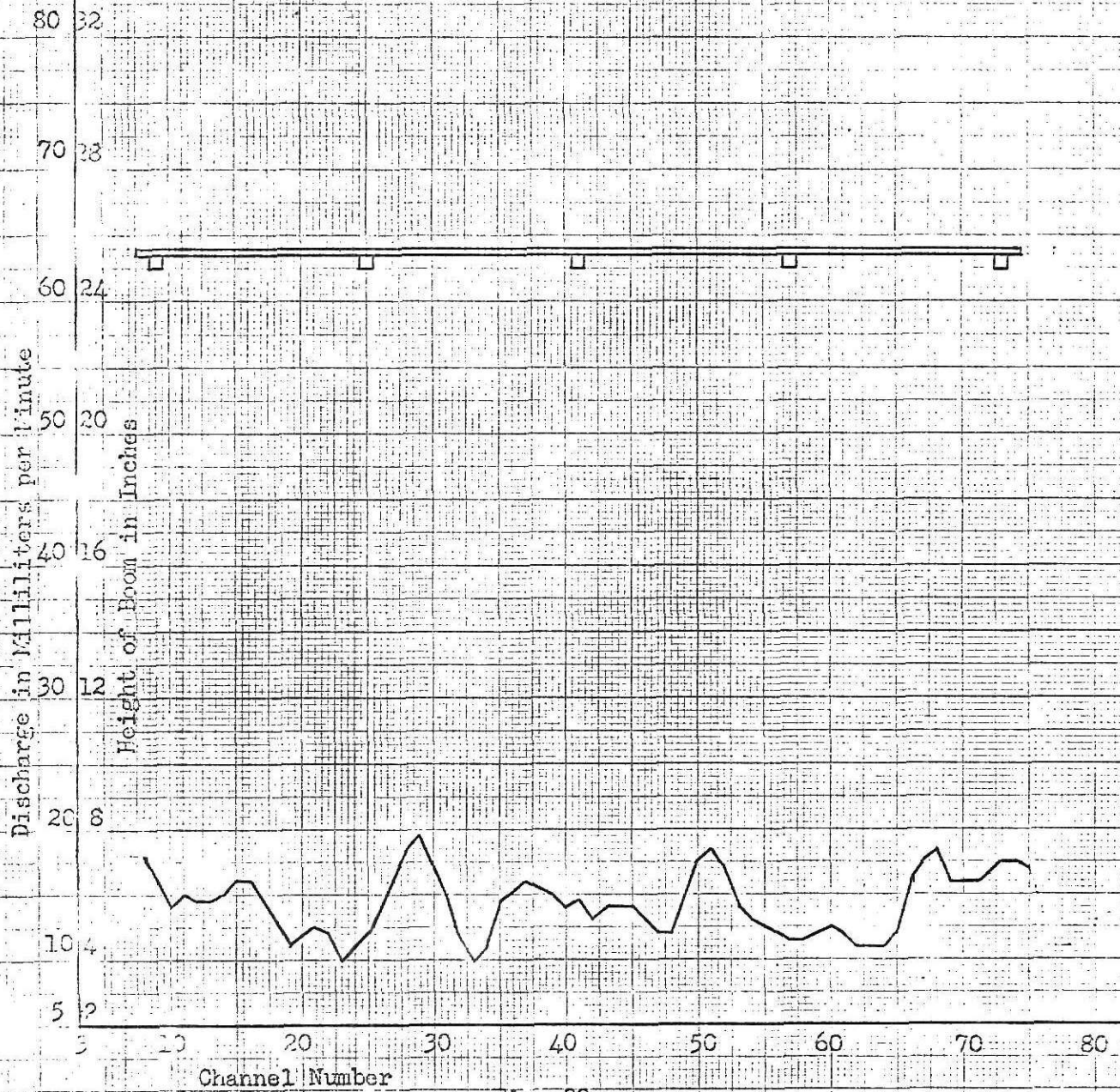


Fig. 32

Explanation of Fig. 33

Effect of Nozzle Height Series Test

Distribution Pattern of Spraying Systems Tee Jet
Cone Type Nozzles No. TX3, with 100 mesh screen,
rated at 2.5 GPA at 75 psi pressure and ground
speed of 4 mph.

Conditions of Test:

Nozzle pressure = 60 psi

Nozzle spacing = 20 inches

Nozzle height = 29 inches

Spray Boom

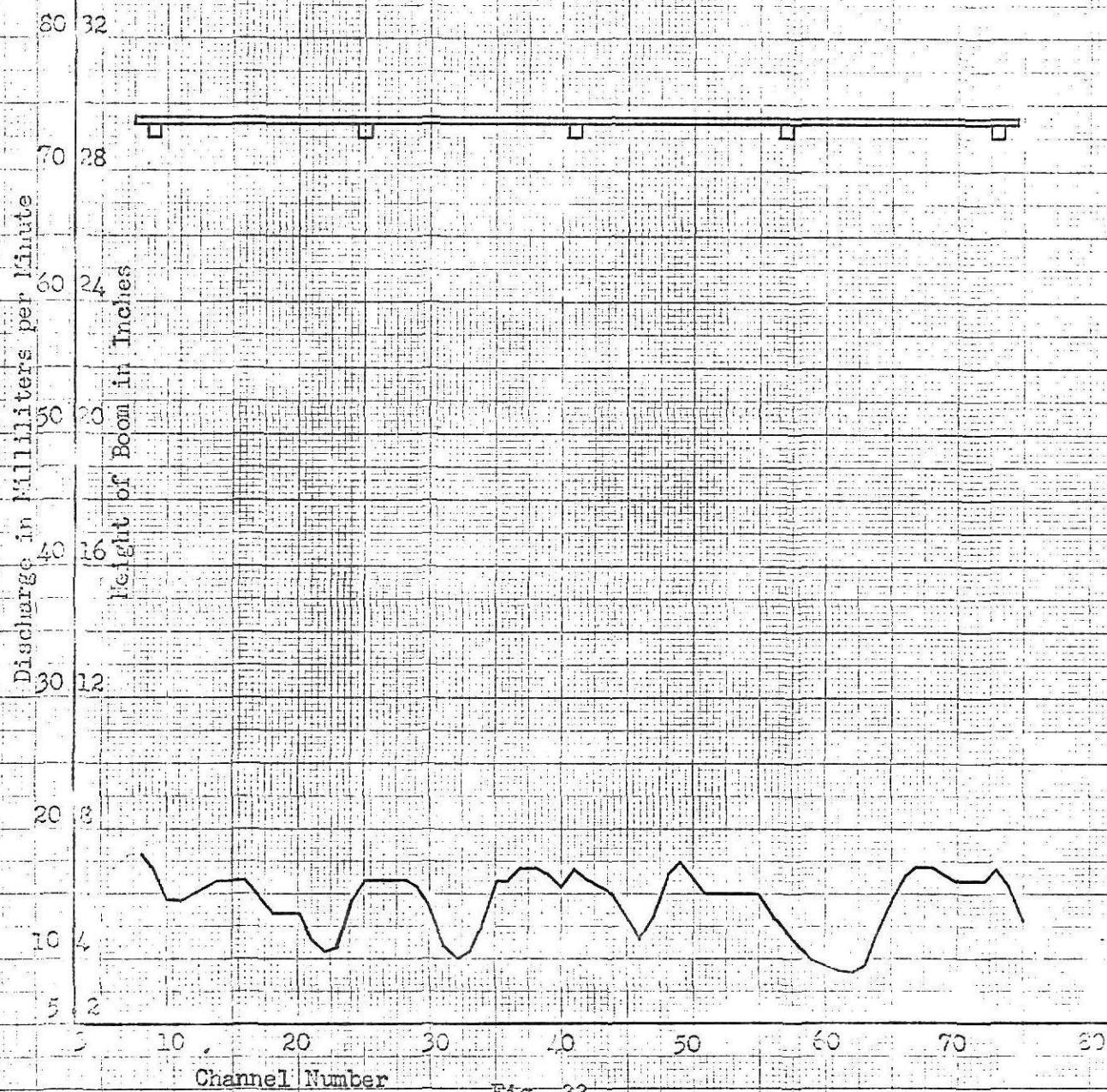


Fig. 33

noticed (Fig. 32 and Fig. 33). At the 29 inch nozzle height, with the 20 inch nozzle spacing, the entire surface received double coverage.

SUMMARY AND CONCLUSIONS

The results of these brief series of tests with only one size of each fan and cone type agricultural spray nozzles, show quite conclusively that even with controlled laboratory conditions, where wind drift was not a factor, that nozzle spray distribution patterns are not uniform.

The fan type nozzles gave the best distribution pattern for the tests made at 30 psi with a nozzle spacing of 20 inches and nozzle height of 21 inches. The cone type nozzles performed best at 60 psi, 20 inch nozzle spacing and a nozzle height of 29 inches which gave a double coverage to the entire area.

It is possible of course that additional tests, with the nozzles tested, might have revealed a set of conditions which would have given better performance than any of the recorded tests. As a result of the work done in this brief series of tests it can definitely be stated that pressure, nozzle spacing and nozzle height have considerable influence on the uniformity of the spray application. Since these are only three of the variables that may occur during actual spraying it is very necessary that the operator choose the best possible combination of adjustments. Variations in ground speed and wind drift can further disrupt the uniformity of the spray pattern.

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EFFECT OF PRESSURE, NOZZLE SPACING AND HEIGHT ON
THE DISTRIBUTION PATTERN OF AN AGRICULTURAL FIELD SPRAYER

by

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AN ABSTRACT OF A MASTER'S REPORT

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MASTER OF SCIENCE

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Spraying for weed and insect control is a precision operation and has a tremendous potential for saving a crop or increasing yield. Three variables that may occur during the actual spraying process, namely - the nozzle pressure, nozzle spacing and nozzle height were studied under controlled laboratory conditions.

A special apparatus was constructed for finding the distribution pattern of spray nozzles as influenced by different variables. Spraying Systems Tee Jet nozzles flat fan type No. 730154 and the cone type No. TX3 nozzles were selected for the investigation. Water was selected as the basic spray liquid.

Under the pressure test series for fan type nozzles the best distribution pattern was obtained at 30 psi with a nozzle spacing of 20 inches and nozzle height of 21 inches. The cone type nozzles under the same set of conditions performed best at 60 psi pressure. For the nozzle spacing of 16 inches, the fan and cone type nozzles both gave a double coverage at a nozzle height of 21 inches. The cone type nozzles performed best at 60 psi pressure with a nozzle spacing of 20 inches and nozzle height of 29 inches which gave a double coverage to the entire area.

The results obtained by these brief series of tests quite clearly indicate that even under controlled laboratory conditions the nozzle spray distribution patterns obtained are not uniform. From this investigation it is definite that nozzle pressure, nozzle spacing and nozzle height have considerable influence on the uniformity of the spray application.