OPERATING CHARACTERISTICS OF A TYPE B FEDERAL AIR CLASSIFIER

by

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OPERATING CHARACTERISTICS OF A TYPE B FEDERAL AIR CLASSIFIER

INTRODUCTION

The preparation of this thesis has been concerned with the classification of two substances, Aerocat produced by American Cyanamid Company and Filtrol produced by the Filtrol Corporation. These two substances are used as fluid catalysts in the petroleum industry. Filtrol is a refined form of a natural occurring substance; Aerocat a synthetic catalyst. Both of these catalysts are composed mainly of aluminum silicate with a small amount of iron oxide.

These two substances were chosen in order for one to determine the operating characteristics of the air classifier, because of the large amount of work being carried on in the investigation of the physical properties of these catalysts.

A perfect classifier might be defined as one that would take a feed and separate it into two portions, the finer of which contained no particles coarser than a given size and the coarser of which contained no particles finer than a given size (2,161).

The problem was to determine by varying conditions what degree of separation could be effected by the Federal Air Classifier. The method of particle-size measurement was by the use of a microscope equipped with a filar

eyepiece. Even with the inherant errors involved in the use of a microscope in measuring particle size, this method proved to be the most satisfactory one.

APPARATUS

The Federal Air Classifier used in this experiment consisted essentially of an 8-inch cyclone, 12-inch cyclone, blower, motor, screw, conveyor, half-gallon hopper for feed, two 1000cc ball flasks, six cloth bags, and a 4-inch copper manifold for the cloth bags. The 8-inch cyclone is referred to as the classifier and the 12-inch cyclone as the collector. Figure 24 gives a diagram of the unit.

The catalyst was introduced to the half-gallon hopper secured above the screw conveyor. The 5/8-inch conveyor is designed to carry 1/5 of a cubic inch per revolution. One finds it possible to reduce the rate of feed by the use of cone inserts constructed from enamel stock paper. The screw conveyor discharged the sample into the 1½-inch conveying pipe entering the 8-inch diameter classifier tangentially, the nipple being connected to direct the air in a counter-clockwise direction. The primary intake of this 1½-inch pipe was fitted with a graduated pressure V-valve which adapts the instrument to products of any specific gravity (3,1).

Air used to control the particle size of the sample which was delivered to the intermediate flask entered the classifier through a graduated mesh M-valve applied to

direct the air in a clockwise direction. Both the M- and V-valves were graduated from 1-30. The M-valve regulated the maximum size of particles sent to the intermediate flask. No material reduced to 200 mesh or any greater mesh is too fine to be conveyed and classified with this unit. Because of the numerous articles written on the theory of cyclone performance and referred to in the bibliography the writer feels it necessary to mention here only the fundamental idea of cyclone operation.

Experimental investigation of cyclones has shown that flow within the cyclone is composed in the main of an outer downward spiral and an inner upward spiral of higher velocity. The rotational velocity at any point in the cyclone below the exit duct varies inversely as the square root of the radius. Friction losses in the cyclone vary as the square of the inlet velocity, and for a given velocity friction varies directly as the height of the inlet and the inlet width and inversely as the square of the exit diameter (4,972).

If for any reason in the future it is desired to duplicate the results of this thesis, Table 1 gives the

velometer[1] readings taken at the V-valve setting of 15, an operation which determined whether the pressure drop through the apparatus was the same. The pressure drop is determined in this apparatus according to the amount of material collected in the bags.

There are various methods for determination of average particle size. The method selected is dependent upon the material under consideration. When the particles are confined to small limits of size, screens of microscopic methods of direct measurement may be used. On the other hand, when the distribution is over a wide range of sizes, indirect methods such as sedimentation and centrifuging are used (2,59).

When the writer determined the particle size of the rejects, intermediates, and fines, a monocular microscope with a filar eyepiece was used. All measurements were made using the 44 X objective, and 10 X eyepiece.

The filar eyepiece is composed of lens, scale, and moveable cross-hair attached to a micrometer. The cross-hair is made to traverse the field by means of a screw

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[1]The velometer is an instrument for measuring the velocity and pressure of air. In appearance it is quite similar to an electrical meter. The air enters the left hand port and leaves through the right hand port. The total cubic feet of air per minute is equal to the product of the velometer reading and the total free intake area.

provided with a micrometer thread, the amount of movement being indicated by the number of revolutions of the graduated micrometer drum attached to the screw head.

Before using the microscope assembly, it was necessary to calibrate the filar eyepiece. Table 4 shows results of this operation. Calibration was done as follows: A standard draw tube setting of 160 mm was used; a standard slide with a scale 2 mm in length divided into 200 parts was placed below the objective; the standard scale and the filar eyepiece scale were brought in line to determine the number of divisions of the micrometer scale required to move the crosshair across a given number of divisions on the standard scale.

EXPERIMENTAL PROCEDURE

Each run with the classifier was made using a 1000-gram sample of catalyst which was placed in the half-gallon hopper. The V-valve was set at the desired setting. The M-valve was stepped up in easy stages at a constant V-valve setting. Each setting of the M-valve constituted a run. At the completion of each run the weight of rejects and the weight of intermediates were recorded. The weight passed over to the cloth bags was obtained by difference. When the setting of the M-valve was increased, the greater intake of air to the classifier increased the quantity of sample forced up through the top exit of the classifier and over to the collector. Figures 2, 3, 12, and 13 indicate the percent by weight of the catalyst that passed to the intermediate and reject flasks at the constant V-valve setting and varying M-valve settings. In order for one to prevent contamination, the approach was made from fine to coarse material, a fact which entailed starting at low M-valve settings. If the sample failed to flow readily from the collector, the frame had to be rapped after the motor was cut out. When the classifier was in operation, only two precautions were necessary. Neither the reject nor intermediate flasks could be removed while the machine was in operation or the coarse material would

be carried over. The blower was always started before starting the screw conveyor.

Each run made with the classifier produced three samples to be analyzed for average particle size. The three samples are the rejects, intermediates, and fines. (See Fig. 24.)

Considerable time was spent determining the most satisfactory procedure in preparing slides. Dry slides were very unsatisfactory because the particles did not separate from one another. The use of collodion solution, alcohol, and benzene as dispersing agents all proved to be unsuccessful. The best method found was the use of several drops of water to disperse the sample over which was placed a cover glass. Great care had to be taken to assure even distribution of the particles under the cover glass; otherwise erroneous results would be recorded.

The method of counting the number of various sized particles in a given area was dispensed with in favor of measuring all the particles under the field of vision. All the detectable particles were measured, the writer being fully aware that there were particles below the visible range.

From each sample 100 particles were counted. This may not appear to be a sufficient number of particles

measured for each sample, but because of duplication of sample weights at other settings of the M- and V-valves sufficient checks were obtained to verify all measurements made. Table 2 exhibits how the diameter measurements were recorded.

RESULTS

Figure 1 indicates the particle size distribution of Filtrol. It shows that approximately 75 percent of the particles are below ten microns. This substance had a great tendency to agglomerate both in the classifier and under the microscope, facts which caused undue overlapping of particles in the intermediates and rejects.

Figures 2 and 3 represent the percent by weight of the Filtrol that entered the intermediate flask and reject flask respectively. It was noted that beyond the M-valve setting of 20 the trend was toward no separation. This trend carried on throughout with both substances.

Figures 4-9 were constructed for each constant V-valve setting. At a setting of 5 the separation was not satisfactory but as the V-valve setting was increased, the effect of changes in the M-valve were more pronounced and gave better separation.

The material that passed to the bags consisted entirely of particles below 5 microns. The distribution of visible particles whether it was small or large in quantity was always the same. This is shown by the straight line in each case for the average diameter of the fines. Table 3 shows how the average diameter was obtained from the data. There are other statistical

average diameters that could be used in compiling the data, but because the average diameter was needed for a basis of comparison only, the arithmetic average was used. This arithmetic average is termed "no. average" on the graphs. The weighted average diameter was included to show that the trend is the same regardless of the statistical diameter calculated.

For Filtrol, V-valve settings of 20-30 gave the best results for classification. Between M-valve settings of 3 and 15 the greatest degree of separation was obtained. At low M-valve settings the fine particles appearing in the intermediate cut were relatively free of large particles, but as the M-valve setting increased, the frequency of large-particle occurrence increased. The rejects in all cases contained fine particles. This was caused by the agglomerating tendency of Filtrol. When the rejects were recycled the fine particles could be removed almost entirely (3,1).

Figure 10 shows the maximum- and minimum-sized particles that occurred in the fines and intermediates. The maximum-sized particles follow the number-average diameter curve very well.

Tables 5 and 6 give the weight of intermediates, the average diameter of the intermediates, and the weight

of fines to the cloth bags for both Filtrol and Aerocat.

The particle-size distribution curve for Aerocat had the very same curvature as it did for Filtrol. The difference between the two substances lay mainly in the fact that the smallest particles of Aerocat ran around 6 microns with nothing below 5 microns while Filtrol ran 75 percent below 10 microns. Figure 11 indicates the particle-size distribution of Aerocat.

Aerocat particles were all spherical in shape, which facilitated measurement of the diameters. Filtrol particles were partially spherical, but also contained random-shaped particles. When the area of the catalysts was calculated, a sphere was assumed in both cases. This calculation is only an approximation in the case of Filtrol. Figure 23 shows a comparison of the areas of Filtrol and Aerocat.

Figures 12 and 13 exhibit the weight percent of the Aerocat that appeared in the intermediate and reject flasks respectively. Both substances gave similar curves for the relation.

As with Filtrol, the V-valve setting of 5 gave a poor degree of separation with Aerocat. When the V-valve setting was increased, satisfactory results in classification were obtained as shown in figures 14-19.

The maximum- and minimum-sized particles appearing in the fines, intermediates, and rejects is shown in figures 20, 21, and 22. Appearance of fines in the rejects was very small in comparison with Filtrol.

CONCLUSIONS

From the work done in completing this thesis the following has been concluded:

1. The Federal Air Classifier serves well in eliminating large particles and cutting out the fine particles from the two catalysts.

2. For both Filtrol and Aerocat V-valve settings of 20-30 appeared to give the best results for classification.

3. The M-valve settings of 3-20 were most effective in particle separation. Beyond 20 there was no separation.

4. The overlapping of particles in the intermediates and rejects was more pronounced with Filtrol than Aerocat. (See figures 10, 20, 21, 22.) The overlapping did not occur between rejects and intermediates at low M-valve settings of 3-6.

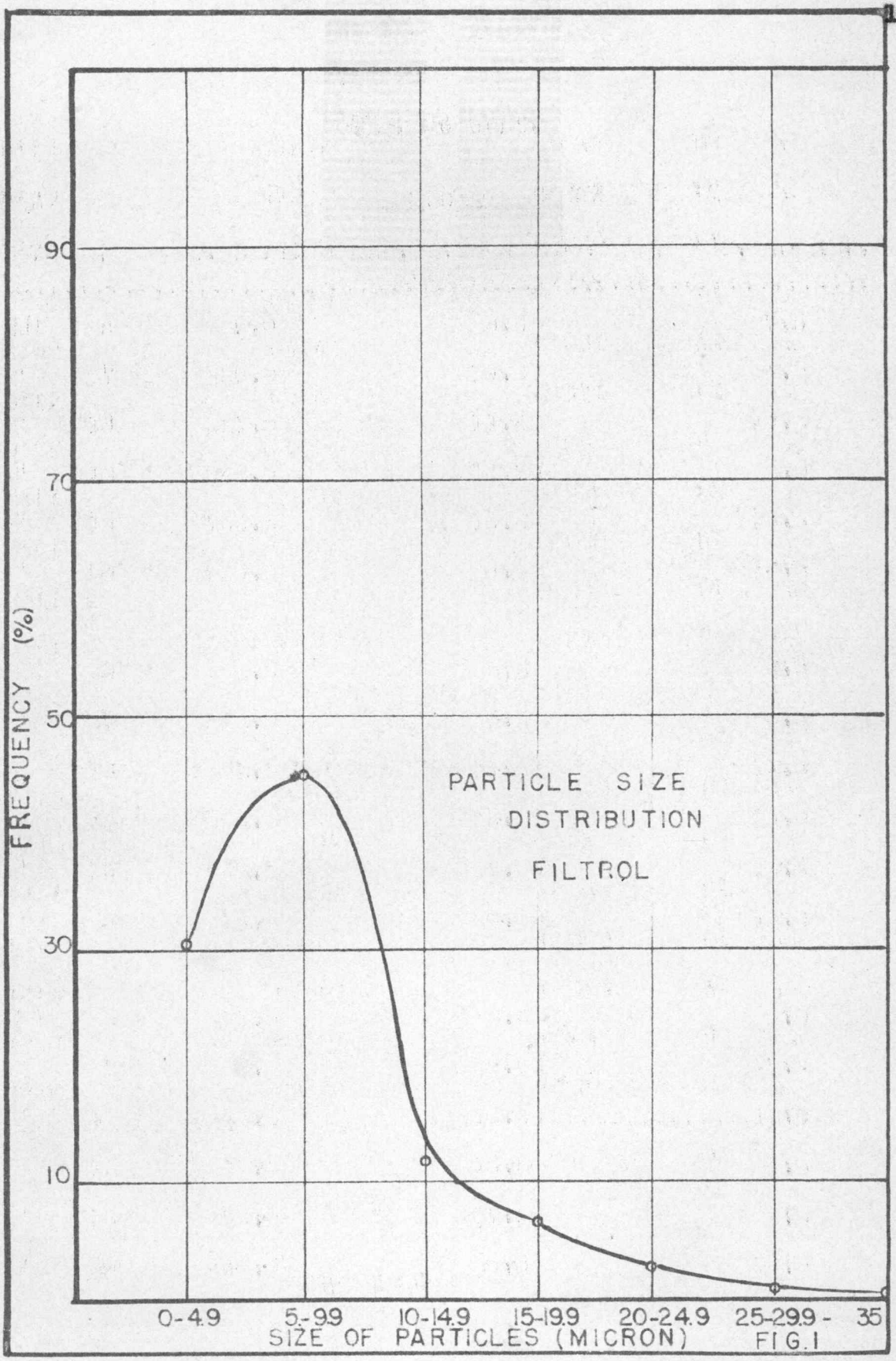
90
70
50
30
10
FREQUENCY (%)
PARTICLE SIZE
DISTRIBUTION
FILTROL
0-4.9
5.-9.9
10-14.9
15-19.9
20-24.9
25-29.9 -
35
SIZE OF PARTICLES (MICRON)

FIG. 1

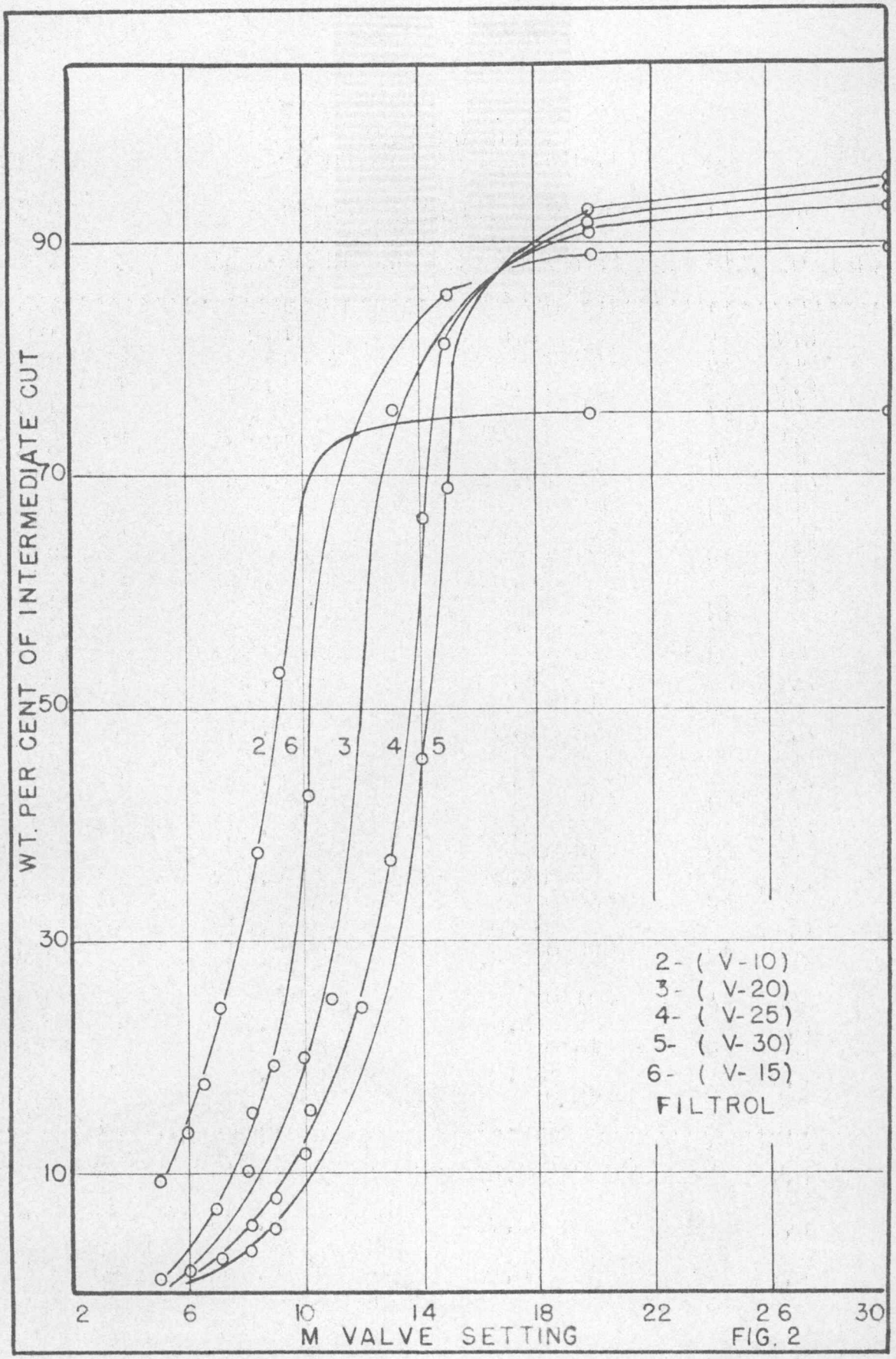
WT. PER CENT OF INTERMEDIATE CUT
90
70
50
30
10
2
6
10
14
18
22
26
30
M VALVE SETTING
2
6
3
4
5
2- (V-10)
3- (V-20)
4- (V-25)
5- (V-30)
6- (V-15)
FILTROL

FIG. 2

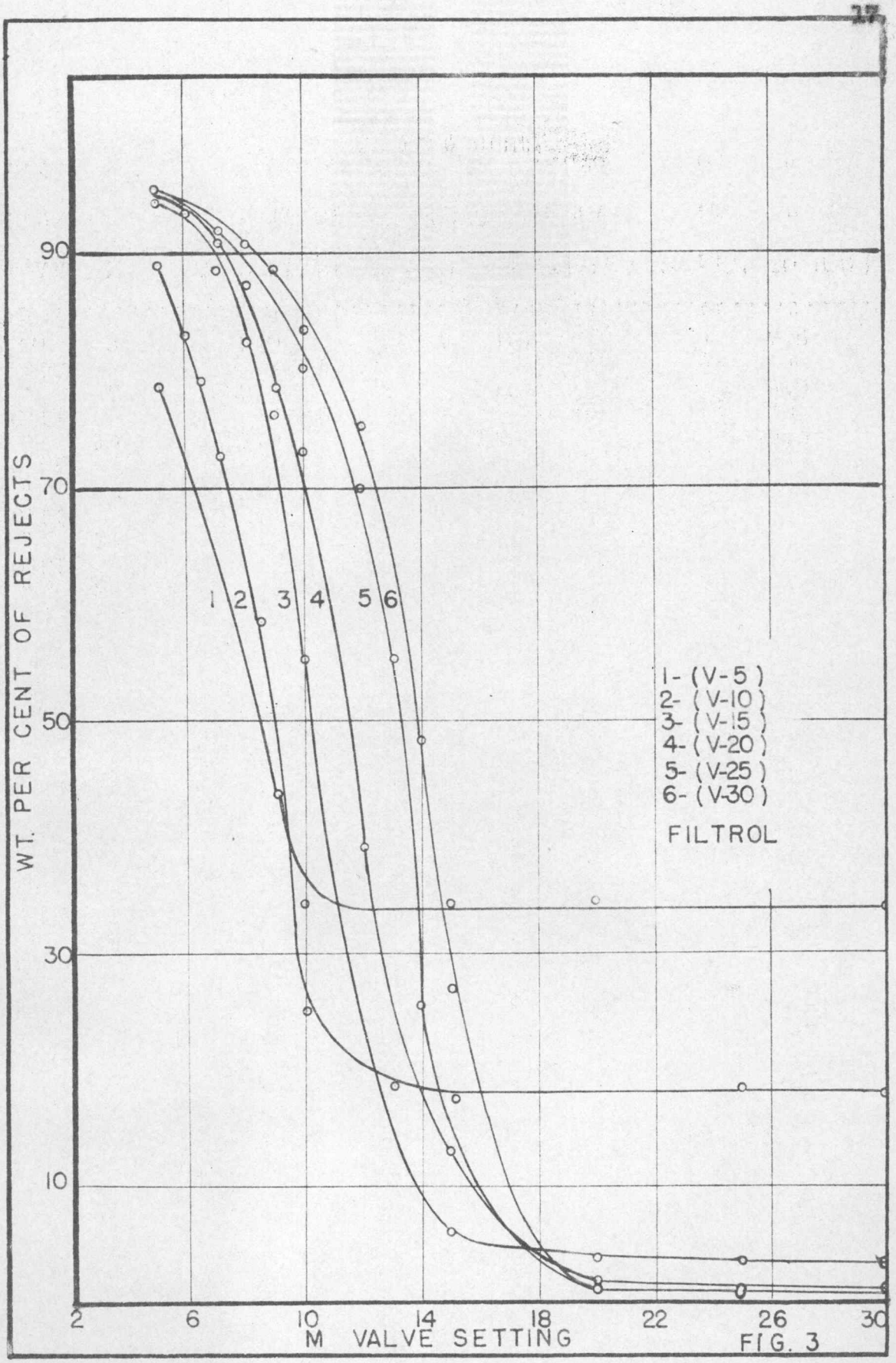
WT. PER CENT OF REJECTS
90
70
50
30
10
2
6
10
14
18
22
26
30
M VALVE SETTING
1
2
3
4
5
6
1- (V-5)
2- (V-10)
3- (V-15)
4- (V-20)
5- (V-25)
6- (V-30)
FILTROL

FIG. 3

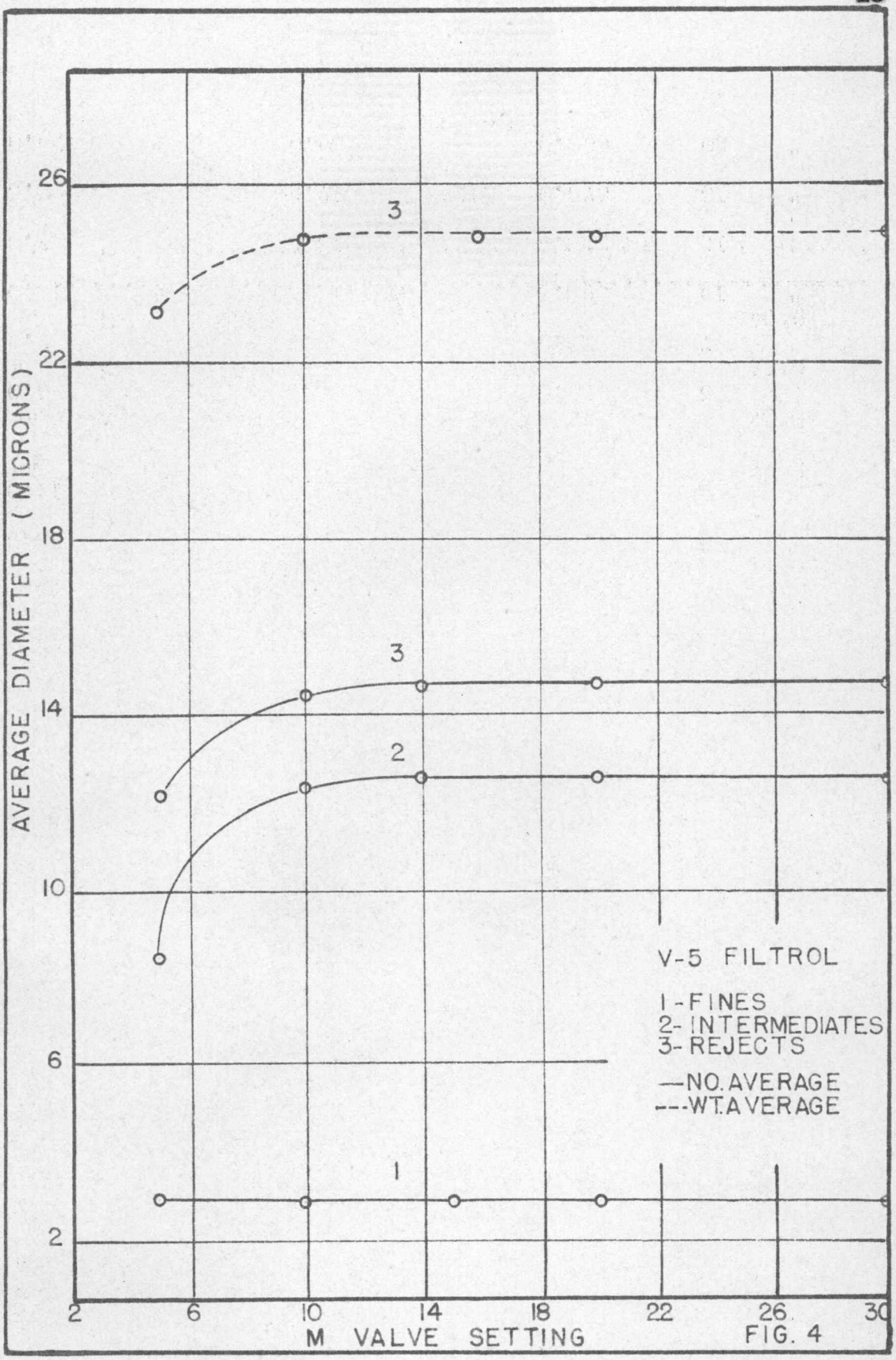
AVERAGE DIAMETER (MICRONS)
26
22
18
14
10
6
2
3
3
2
1
V-5 FILTROL
1-FINES
2-INTERMEDIATES
3-REJECTS
—NO. AVERAGE
---WT. AVERAGE
2
6
10
14
18
22
26
30
M VALVE SETTING

FIG. 4

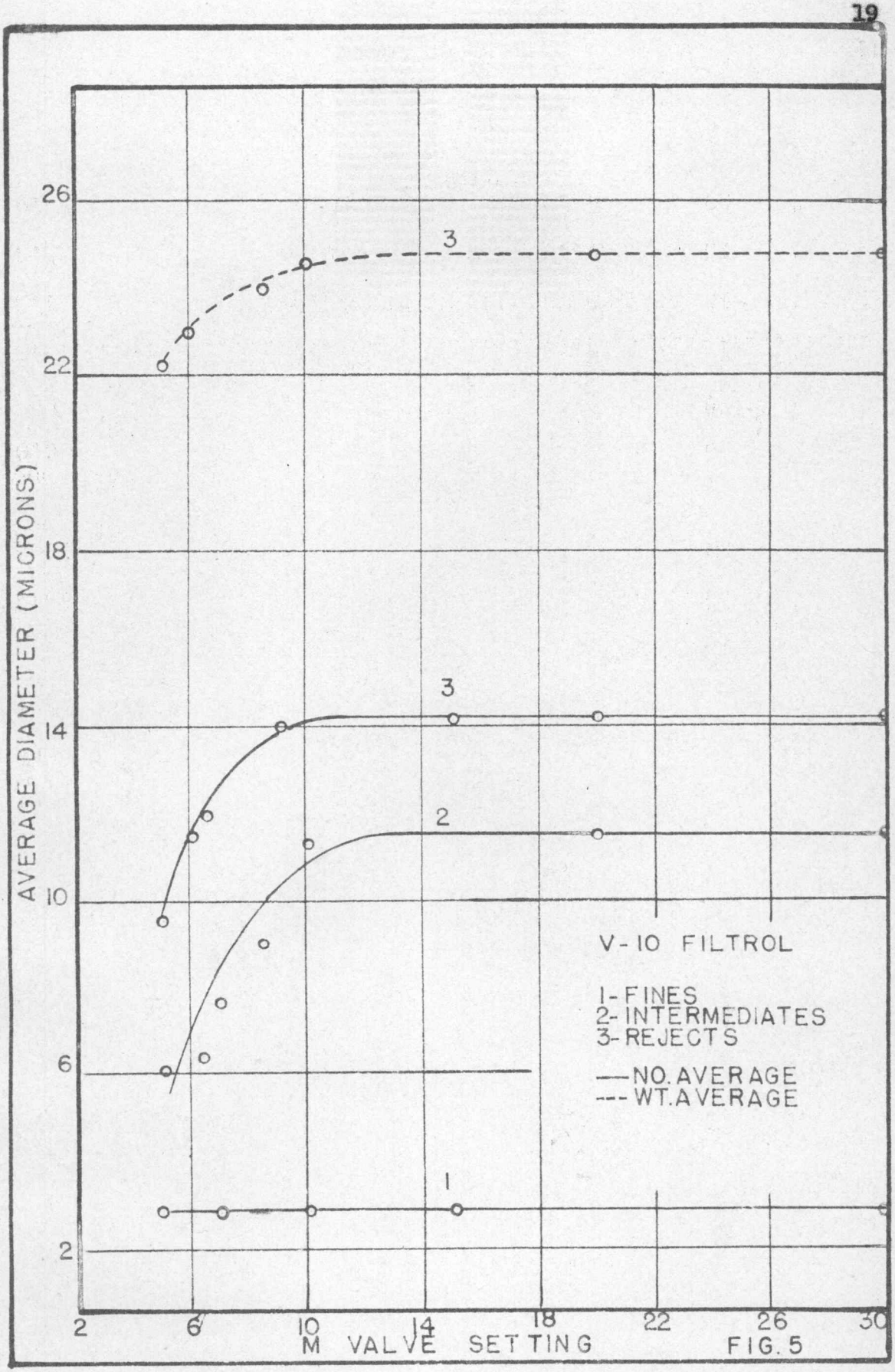
AVERAGE DIAMETER (MICRONS)
26
22
18
14
10
6
2
3
3
2
1
V-10 FILTROL
1-FINES
2-INTERMEDIATES
3-REJECTS
—NO. AVERAGE
---WT. AVERAGE
2
6
10
14
18
22
26
30
M VALVE SETTING

FIG. 5

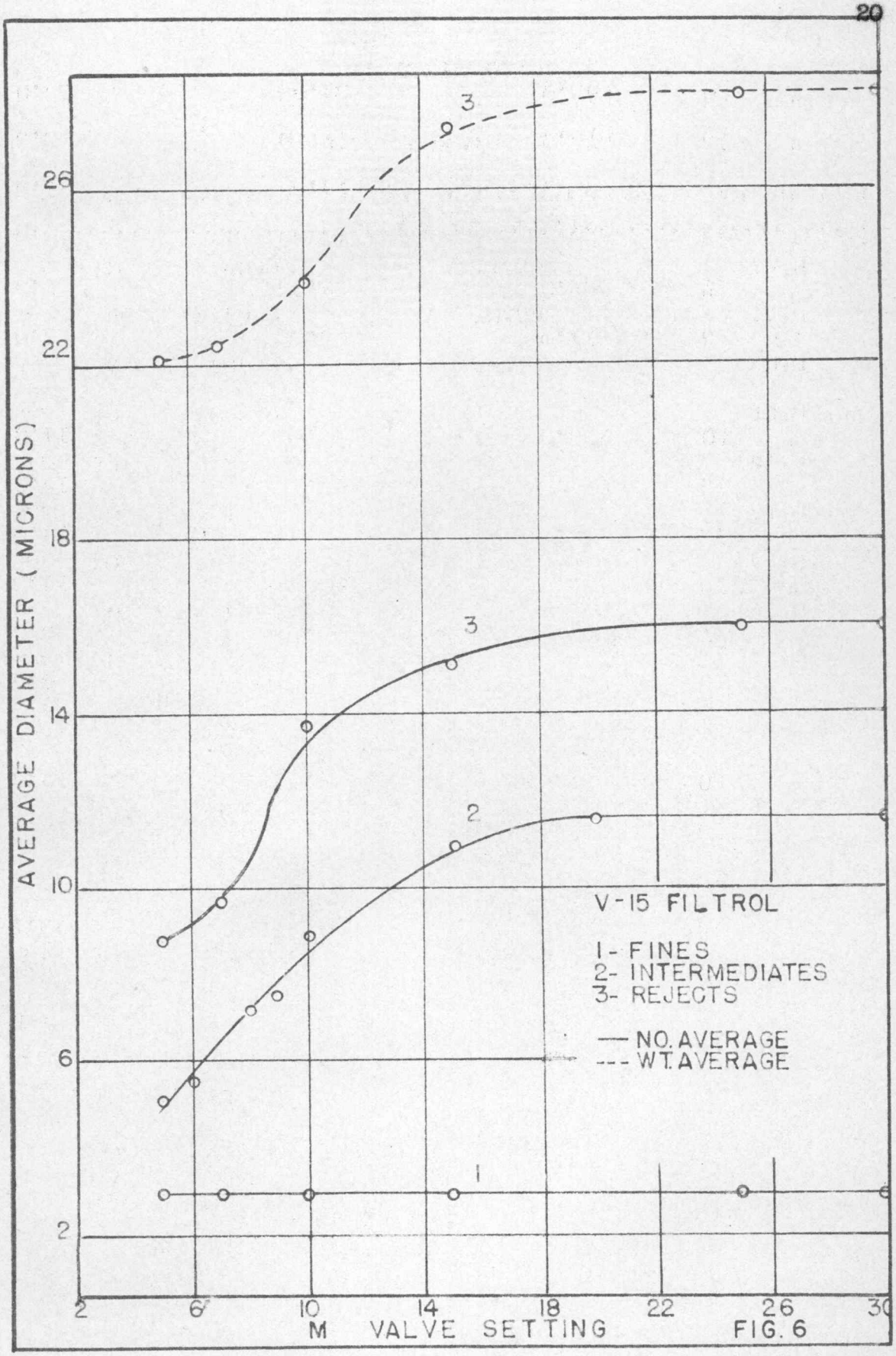
AVERAGE DIAMETER (MICRONS)
26
22
18
14
10
6
2
3
3
2
1
V-15 FILTROL
1- FINES
2- INTERMEDIATES
3- REJECTS
— NO. AVERAGE
--- WT. AVERAGE
2
6
10
14
18
22
26
30
M VALVE SETTING

FIG. 6

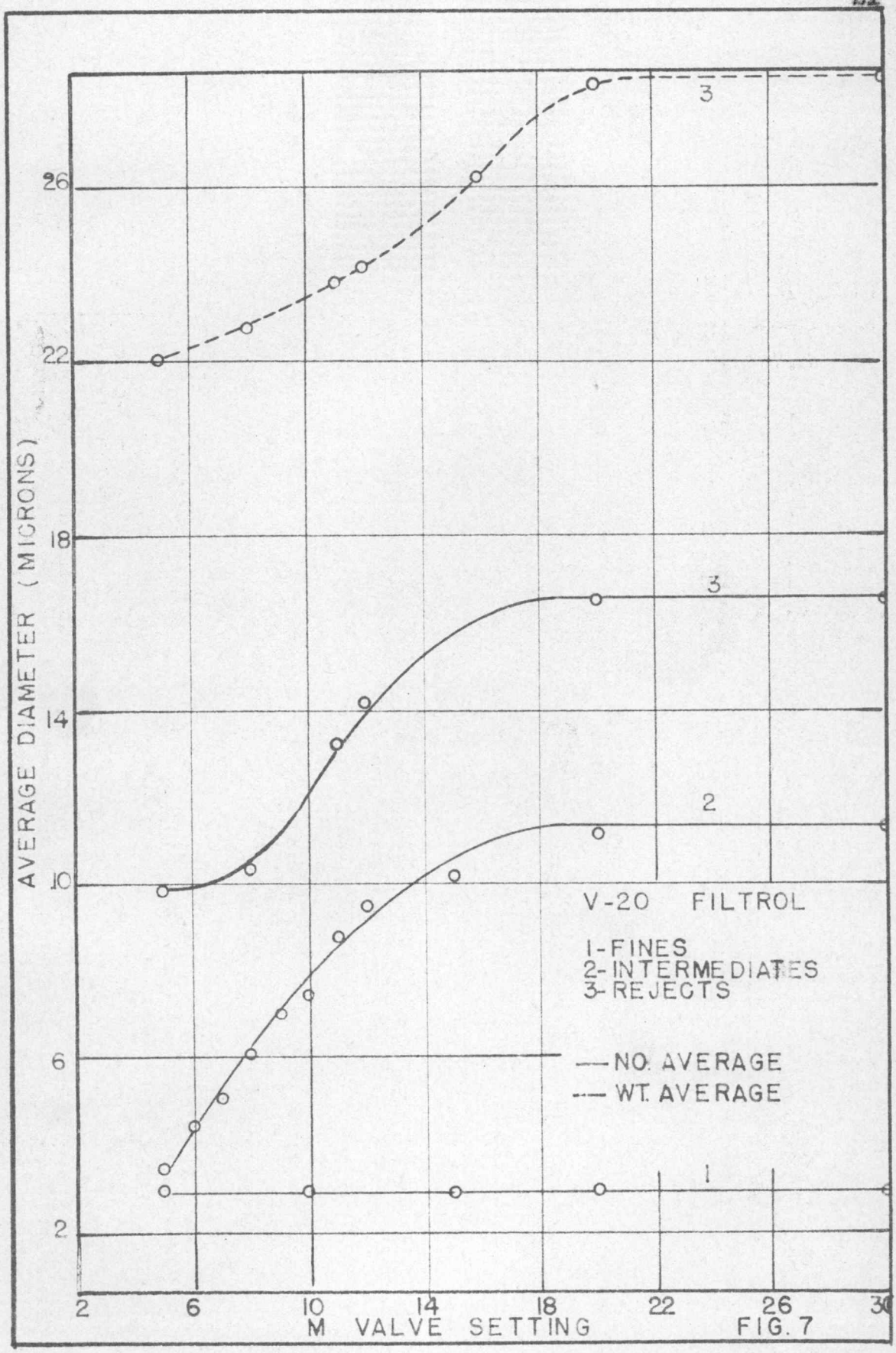
AVERAGE DIAMETER (MICRONS)
26
22
18
14
10
6
2
3
3
2
1
V-20 FILTROL
1-FINES
2-INTERMEDIATES
3-REJECTS
—NO. AVERAGE
---WT. AVERAGE
2
6
10
14
18
22
26
30
M VALVE SETTING

FIG. 7

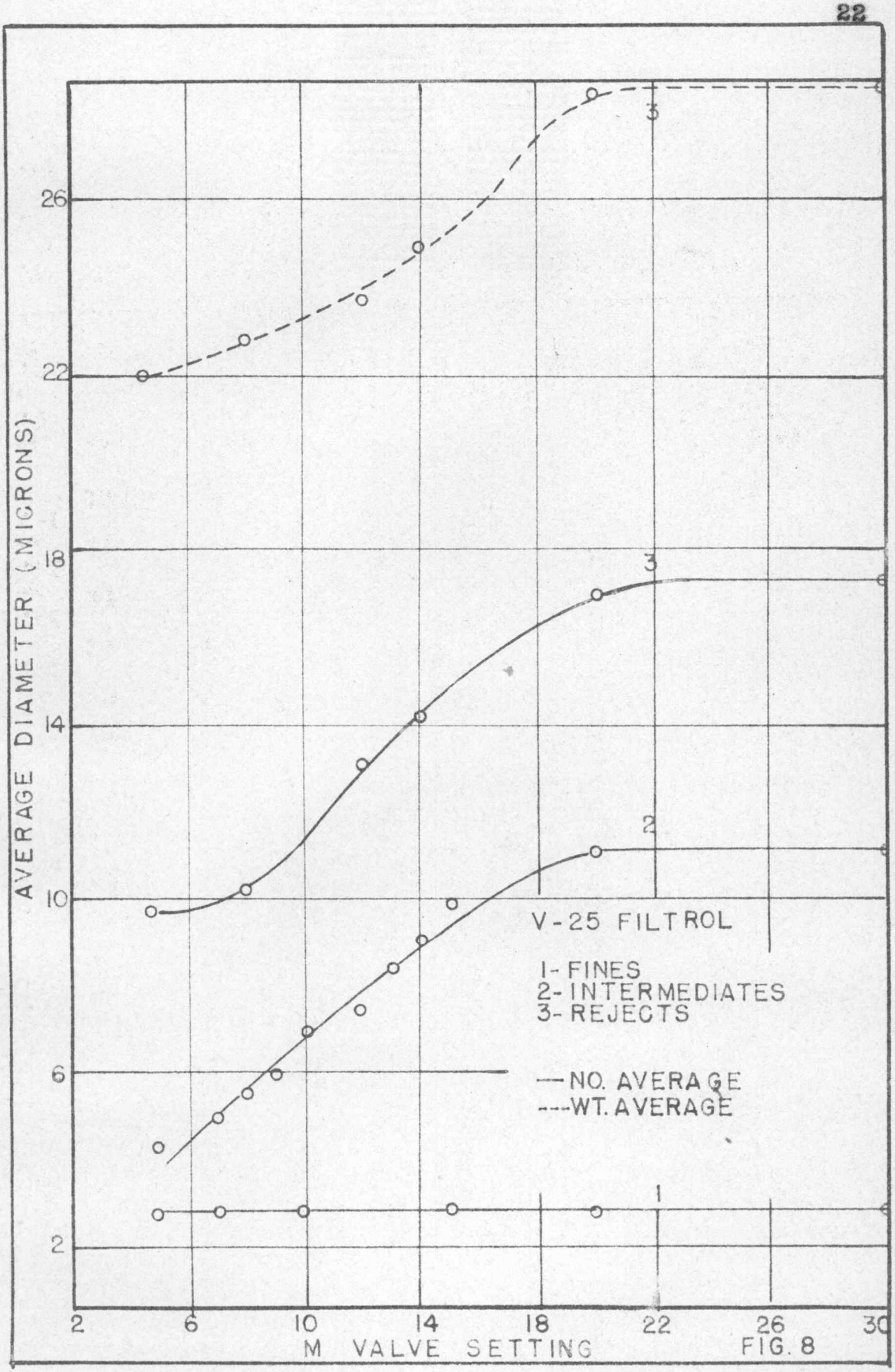
AVERAGE DIAMETER (MICRONS)
26
22
18
14
10
6
2
2
6
10
14
18
22
26
30
M VALVE SETTING
3
3
2
1
V-25 FILTROL
1- FINES
2- INTERMEDIATES
3- REJECTS
—NO. AVERAGE
----WT. AVERAGE

FIG. 8

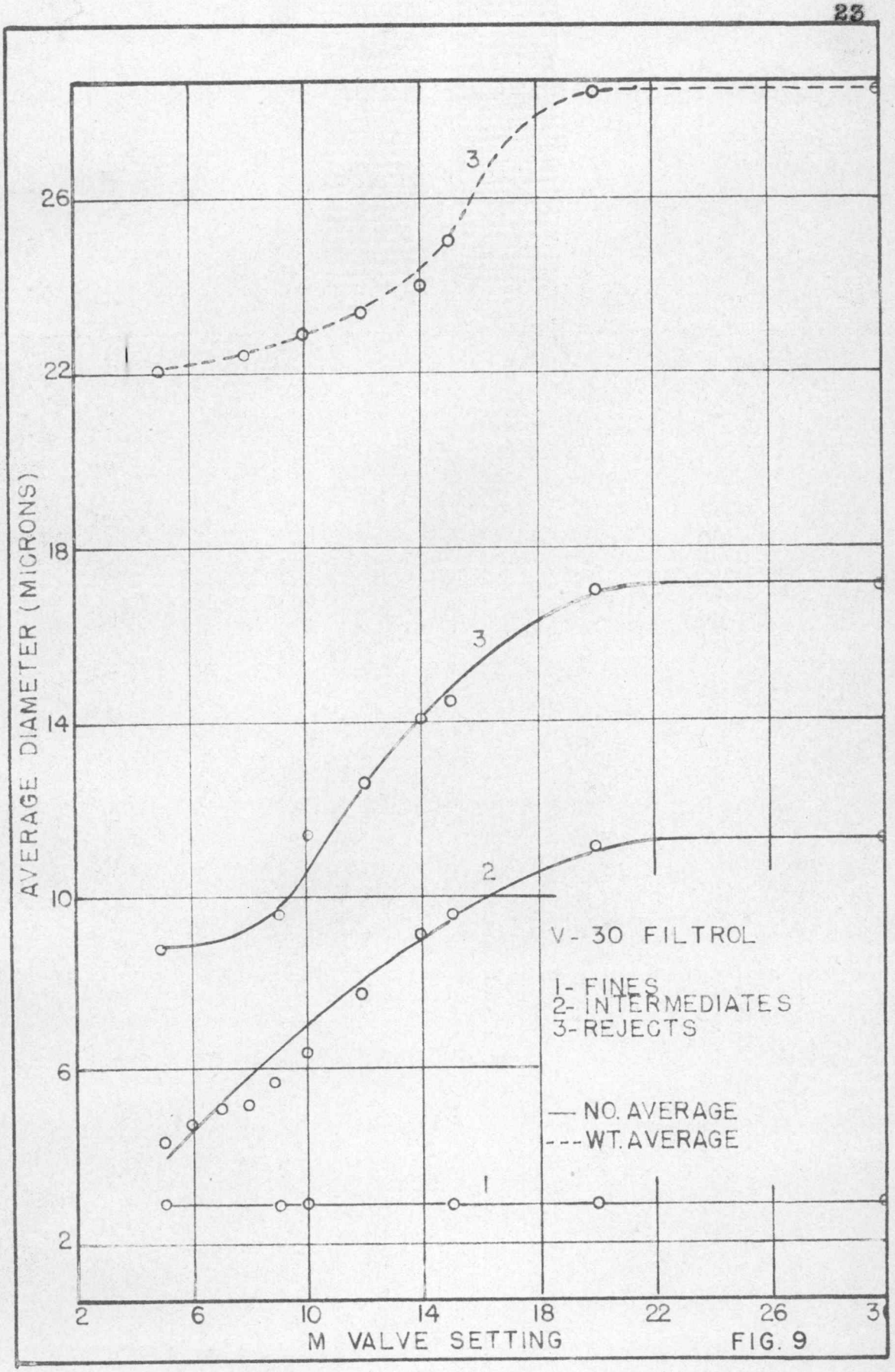
AVERAGE DIAMETER (MICRONS)
2
6
10
14
18
22
26
M VALVE SETTING
V- 30 FILTROL
1- FINES
2- INTERMEDIATES
3- REJECTS
— NO. AVERAGE
--- WT. AVERAGE
1
2
3

FIG. 9

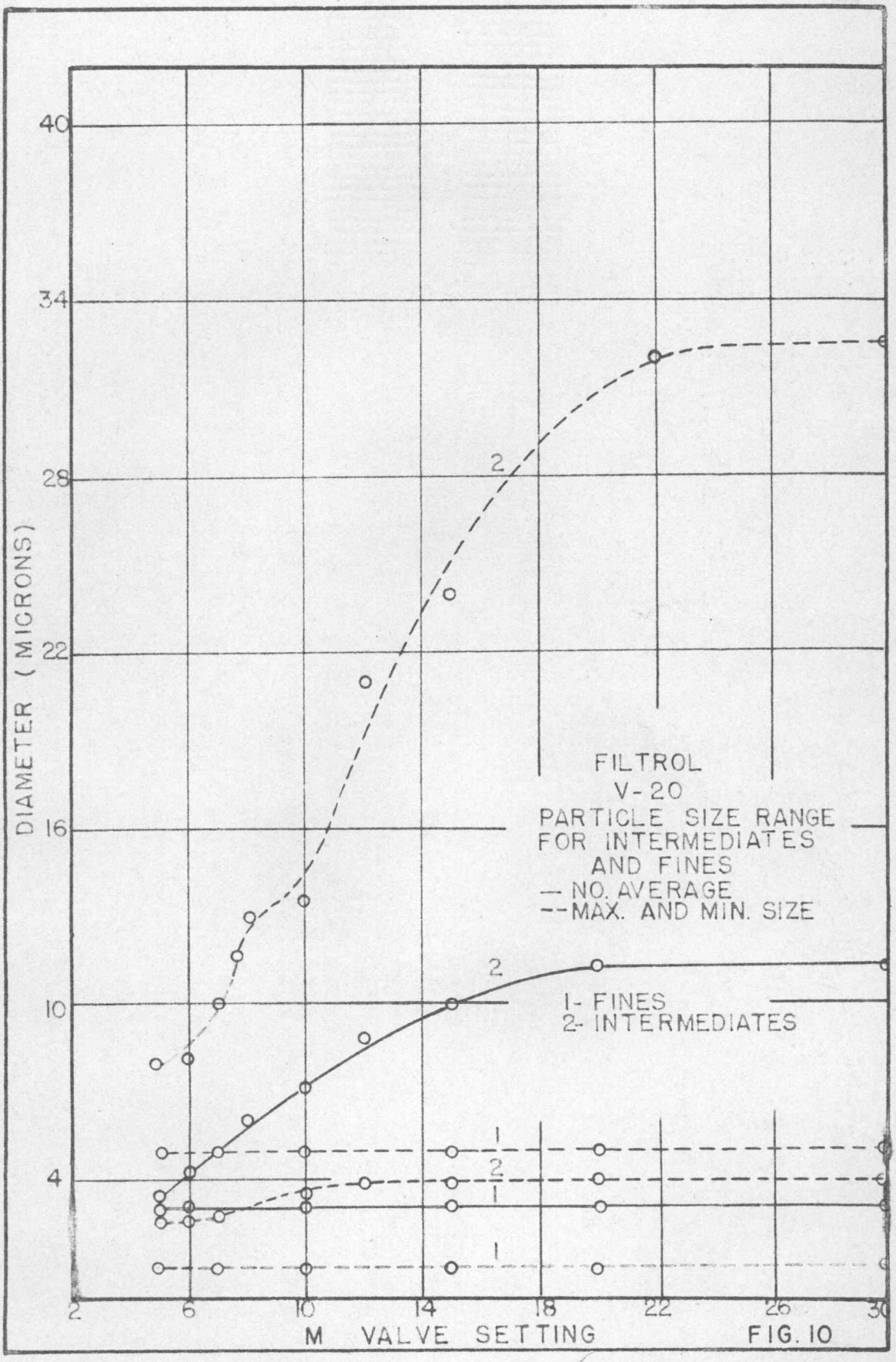
40
34
28
22
16
10
4
DIAMETER (MICRONS)
2
6
10
14
18
22
26
30
M VALVE SETTING
FILTROL
V-20
PARTICLE SIZE RANGE
FOR INTERMEDIATES
AND FINES
— NO. AVERAGE
--MAX. AND MIN. SIZE
1- FINES
2- INTERMEDIATES
2
2
1
2
1
1

FIG. 10

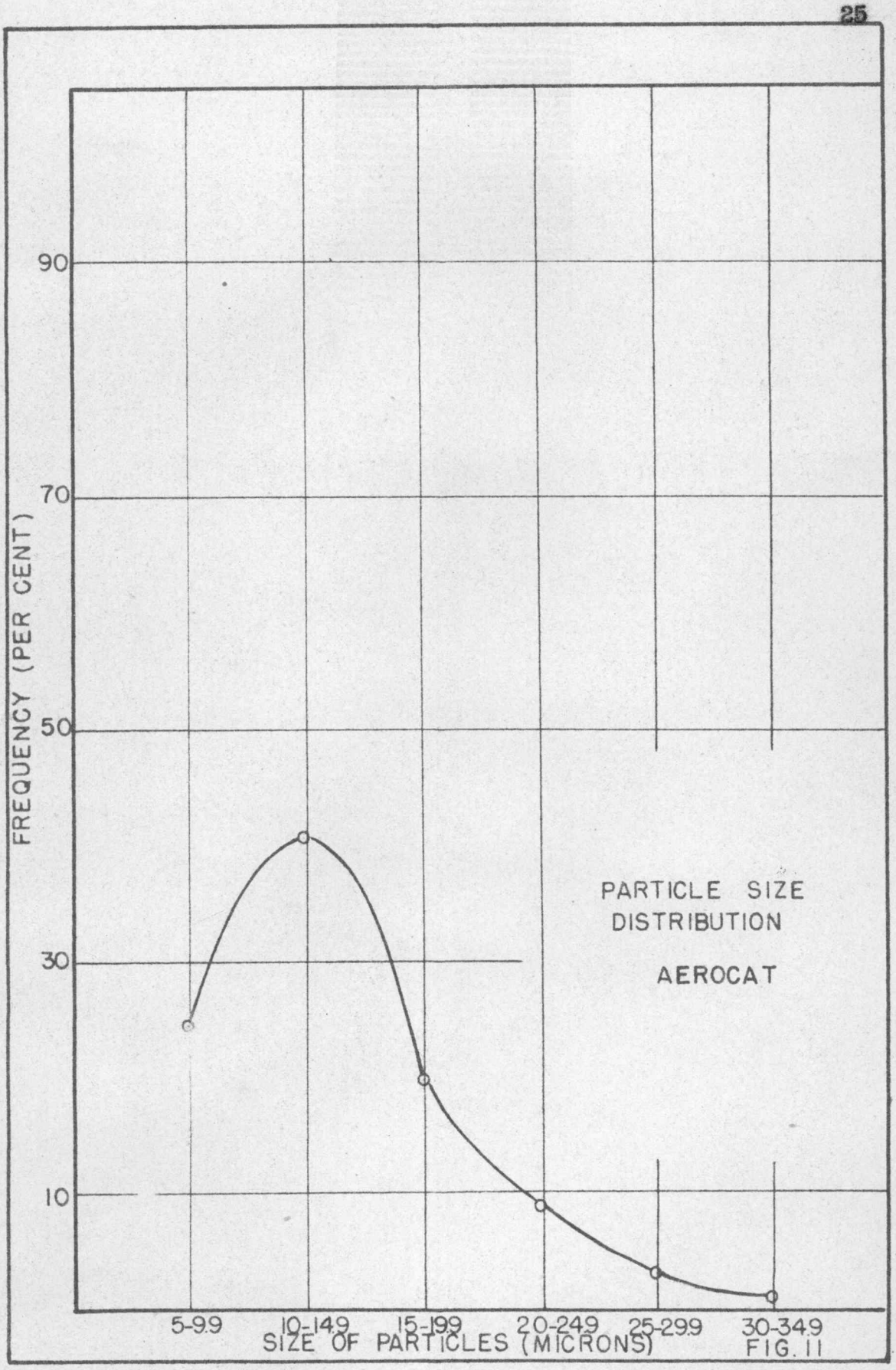
90
70
50
30
10
FREQUENCY (PER CENT)
PARTICLE SIZE
DISTRIBUTION
AEROCAT
5-9.9
10-14.9
15-19.9
20-24.9
25-29.9
30-34.9
SIZE OF PARTICLES (MICRONS)

FIG. 11

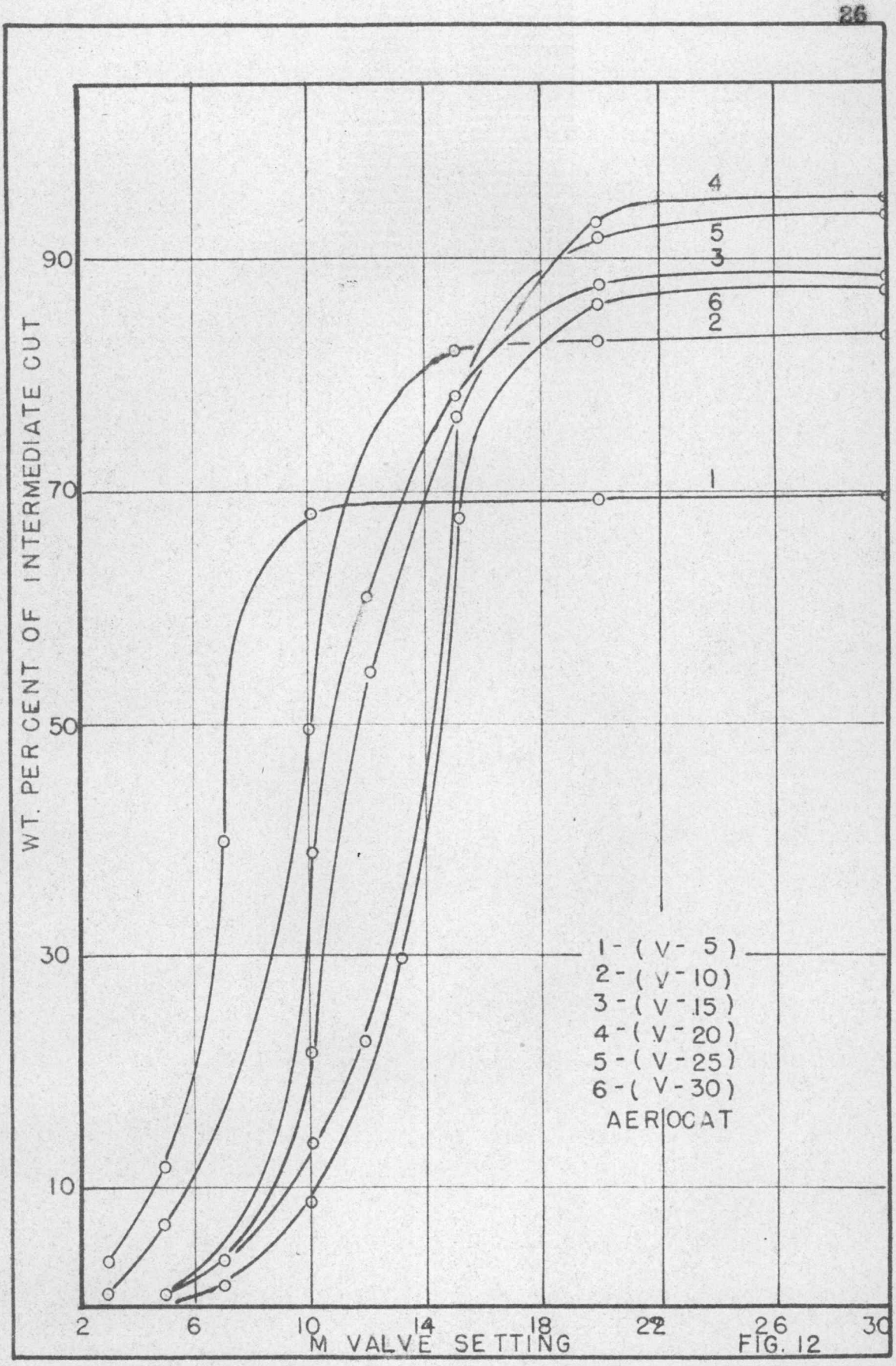
WT. PER CENT OF INTERMEDIATE CUT
90
70
50
30
10
2
6
10
14
18
22
26
30
M VALVE SETTING
4
5
3
6
2
1
1-(V-5)
2-(V-10)
3-(V-15)
4-(V-20)
5-(V-25)
6-(V-30)
AEROCAT

FIG. 12

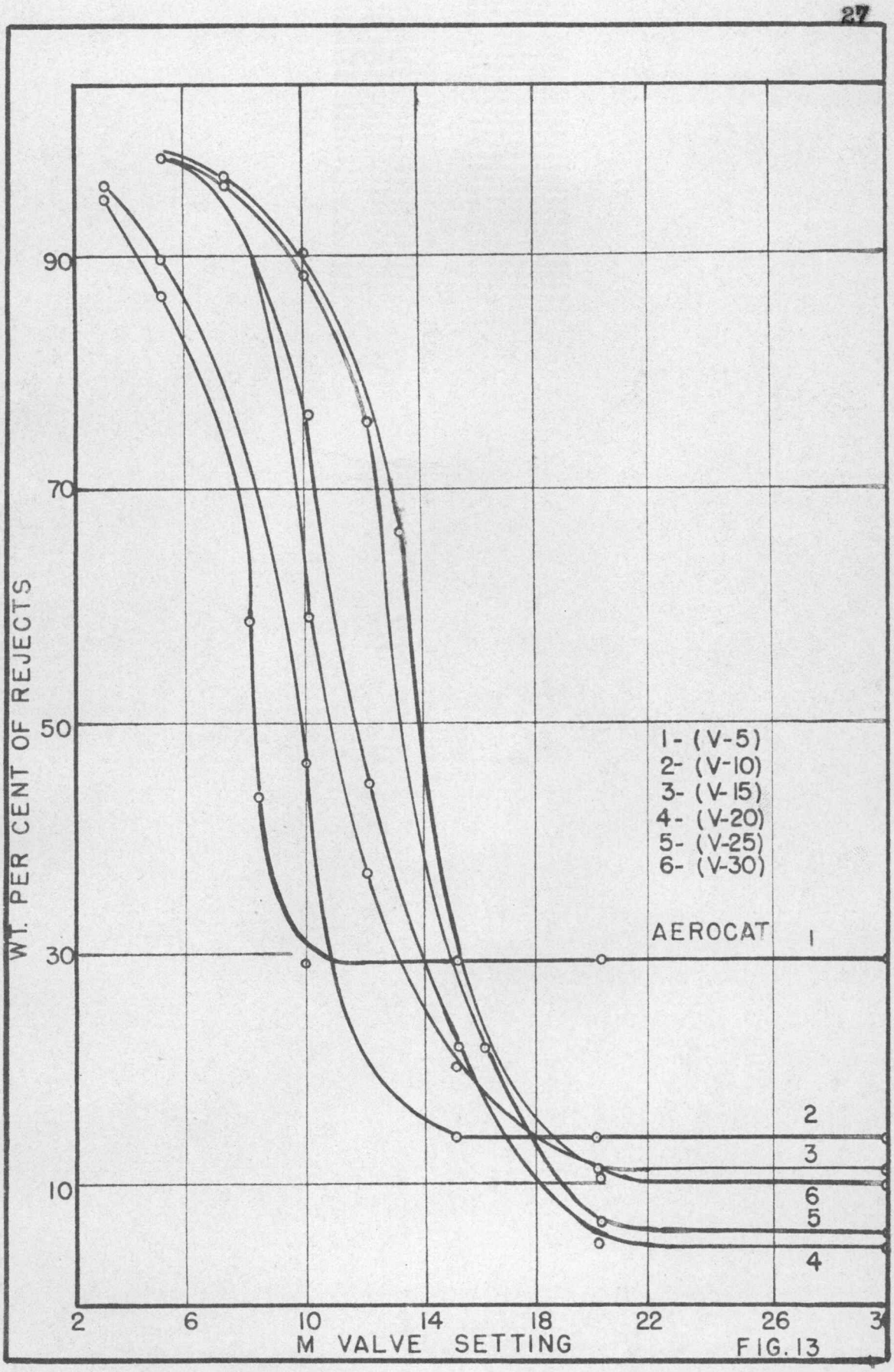
WT. PER CENT OF REJECTS
90
70
50
30
10
2
6
10
14
18
22
26
3
M VALVE SETTING
1- (V-5)
2- (V-10)
3- (V-15)
4- (V-20)
5- (V-25)
6- (V-30)
AEROCAT
1
2
3
6
5
4

FIG. 13

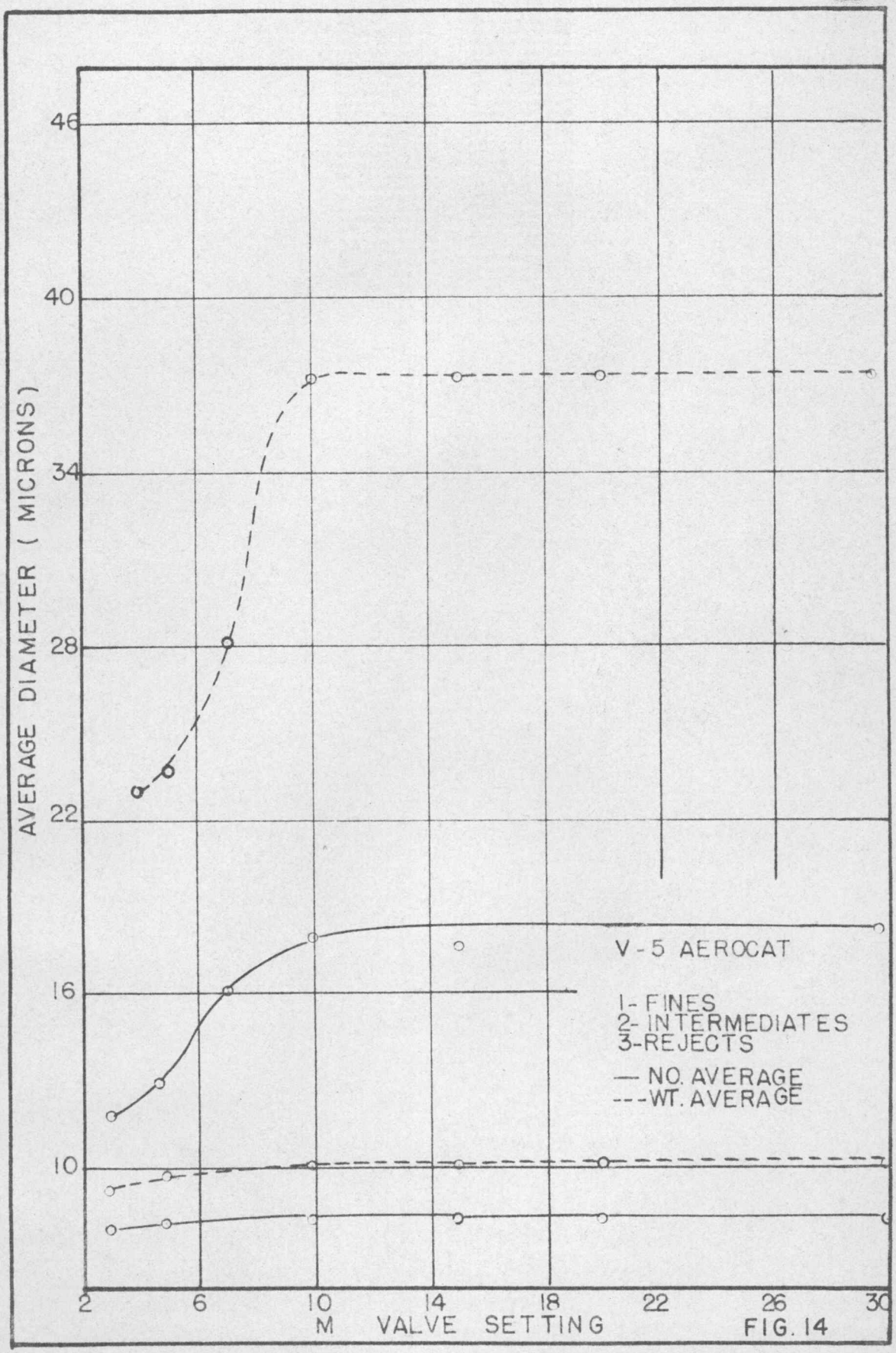
AVERAGE DIAMETER (MICRONS)
46
40
34
28
22
16
10
2
6
10
14
18
22
26
30
M VALVE SETTING
V-5 AEROCAT
1- FINES
2- INTERMEDIATES
3-REJECTS
— NO. AVERAGE
---WT. AVERAGE

FIG. 14

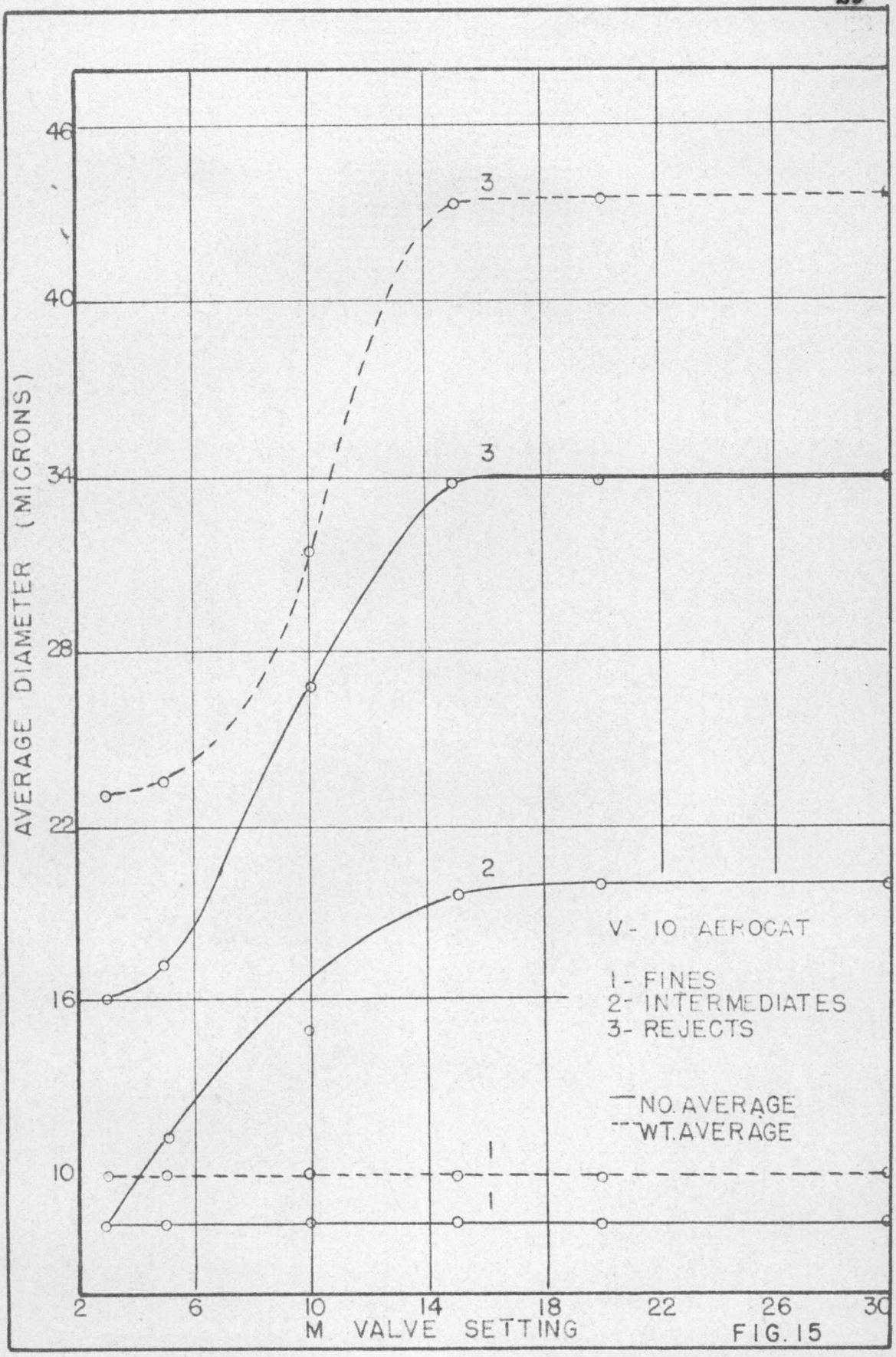
AVERAGE DIAMETER (MICRONS)
46
40
34
28
22
16
10
2
6
10
14
18
22
26
30
M VALVE SETTING
3
3
2
1
1
V- 10 AEROCAT
1- FINES
2- INTERMEDIATES
3- REJECTS
NO. AVERAGE
WT. AVERAGE

FIG. 15

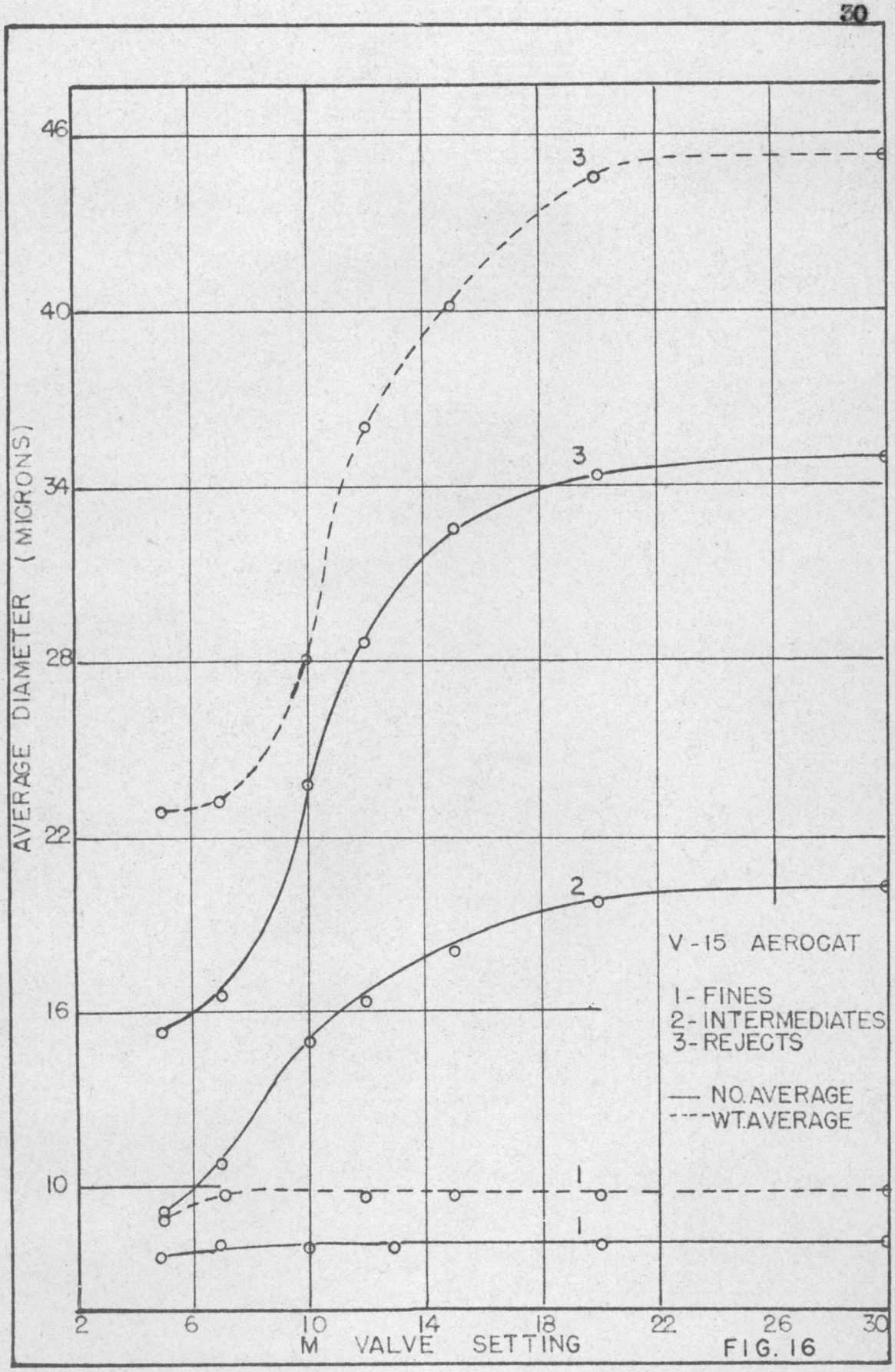
AVERAGE DIAMETER (MICRONS)
46
40
34
28
22
16
10
2
6
10
14
18
22
26
30
M VALVE SETTING
3
3
2
1
1
V-15 AEROCAT
1- FINES
2- INTERMEDIATES
3- REJECTS
NO. AVERAGE
WT. AVERAGE

FIG. 16

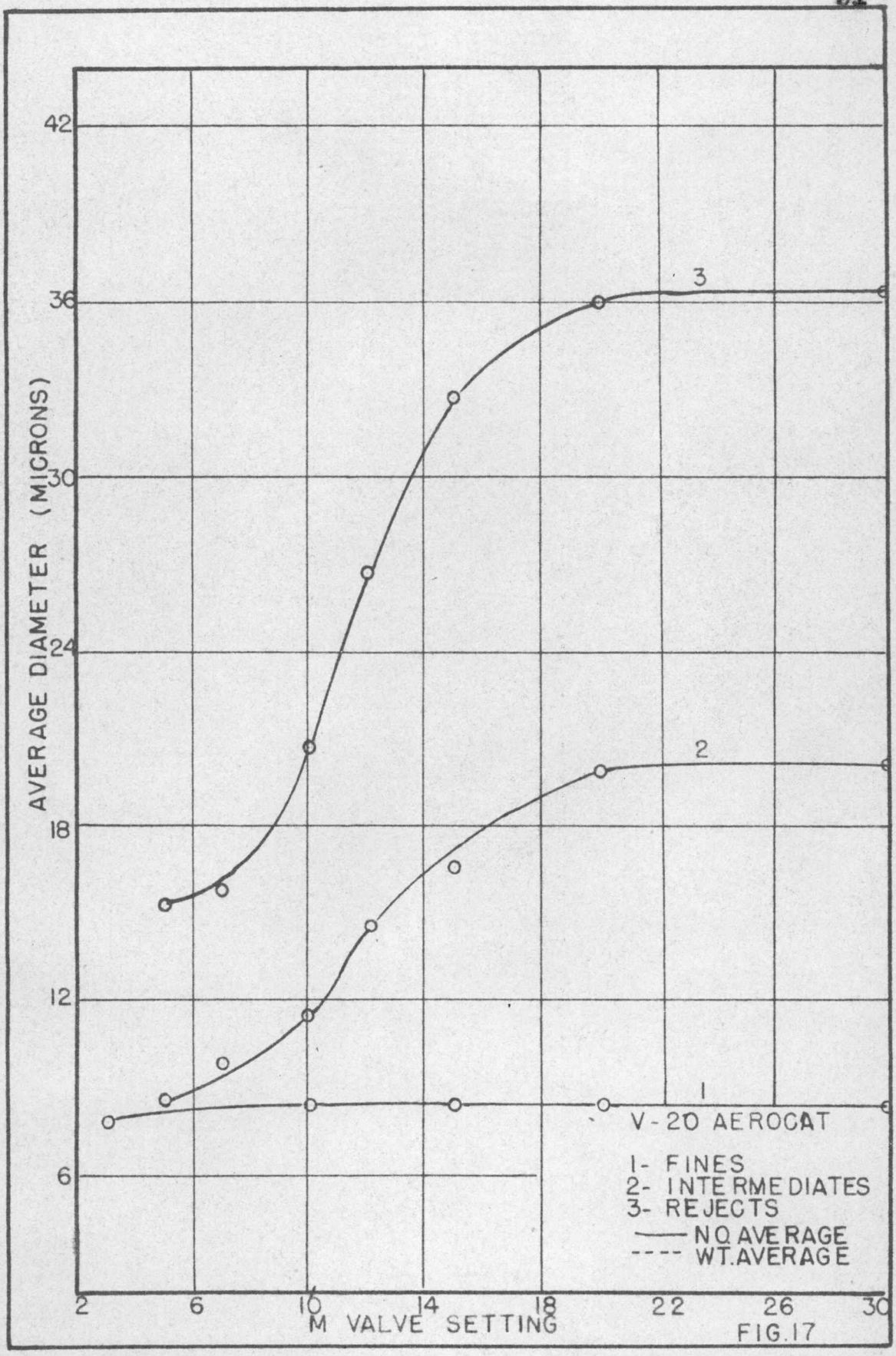
AVERAGE DIAMETER (MICRONS)
42
36
30
24
18
12
6
2
6
10
14
18
22
26
30
M VALVE SETTING
3
2
1
V-20 AEROCAT
1- FINES
2- INTERMEDIATES
3- REJECTS
NO. AVERAGE
WT. AVERAGE

FIG. 17

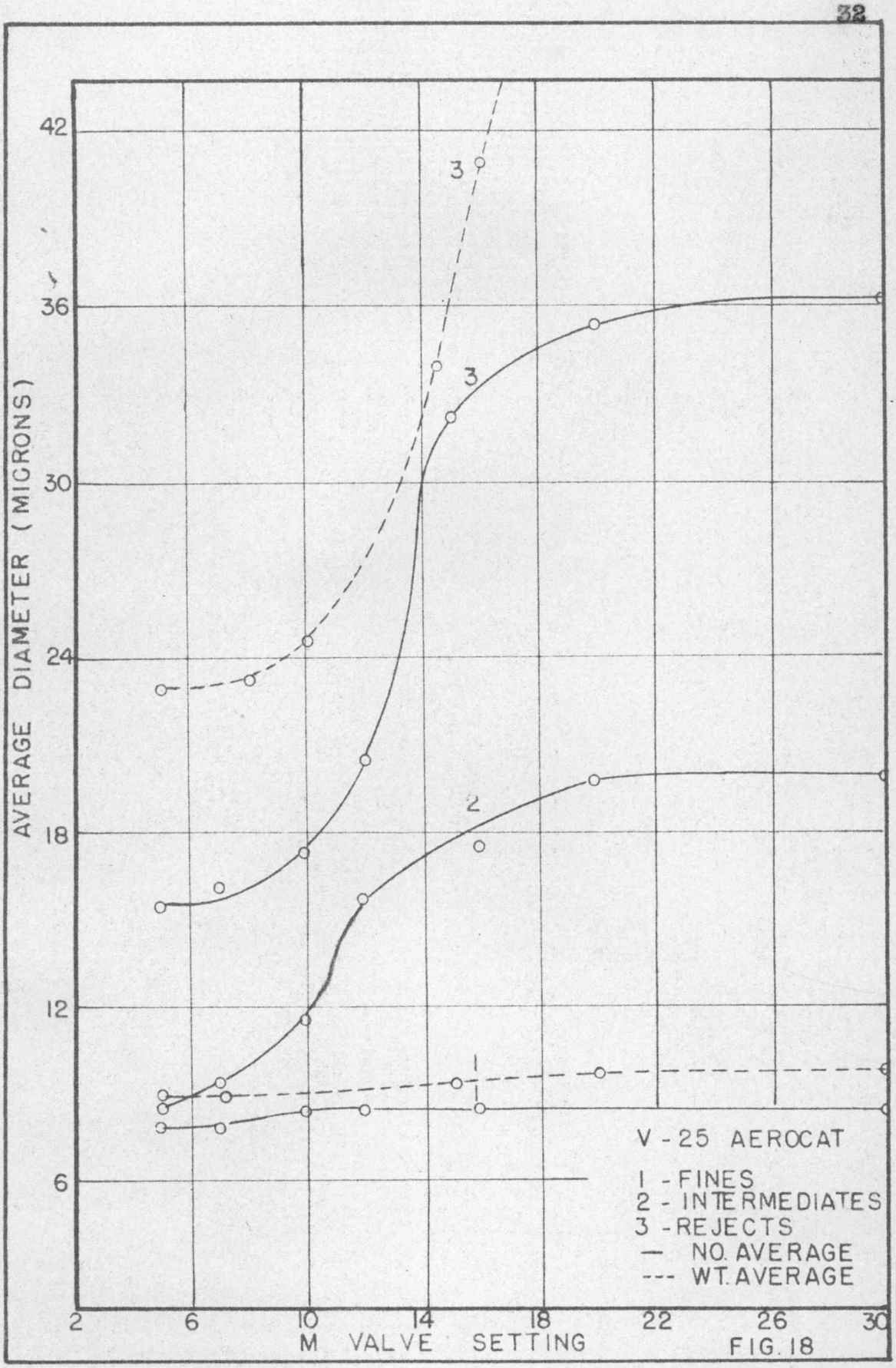
AVERAGE DIAMETER (MICRONS)
42
36
30
24
18
12
6
2
6
10
14
18
22
26
30
M VALVE SETTING
3
3
2
1
V-25 AEROCAT
1 - FINES
2 - INTERMEDIATES
3 - REJECTS
— NO. AVERAGE
--- WT. AVERAGE

FIG. 18

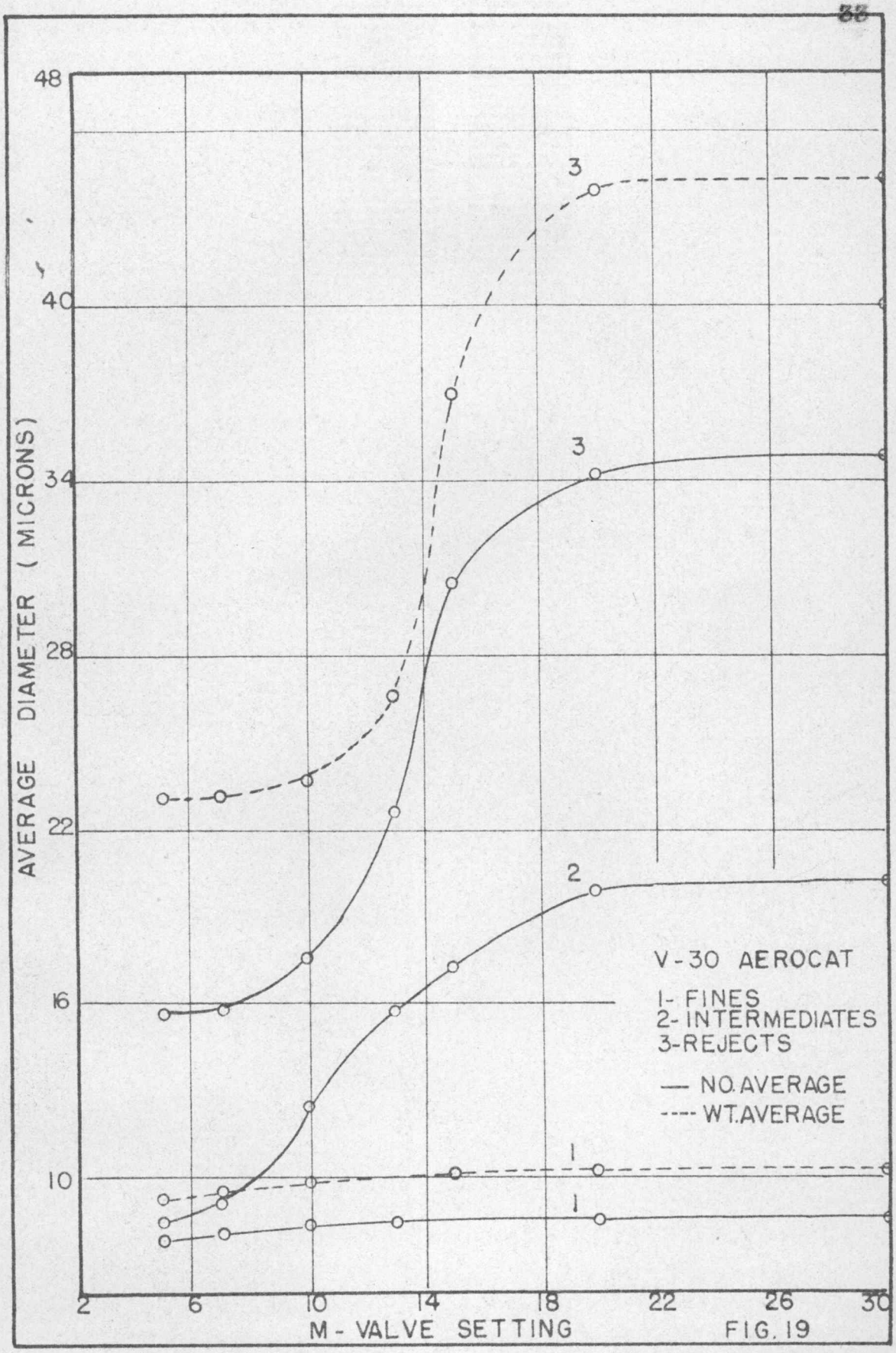
48
40
34
28
22
16
10
AVERAGE DIAMETER (MICRONS)
2
6
10
14
18
22
26
30
M - VALVE SETTING
3
3
2
1
1
V-30 AEROCAT
1- FINES
2- INTERMEDIATES
3-REJECTS
— NO. AVERAGE
---- WT. AVERAGE

FIG. 19

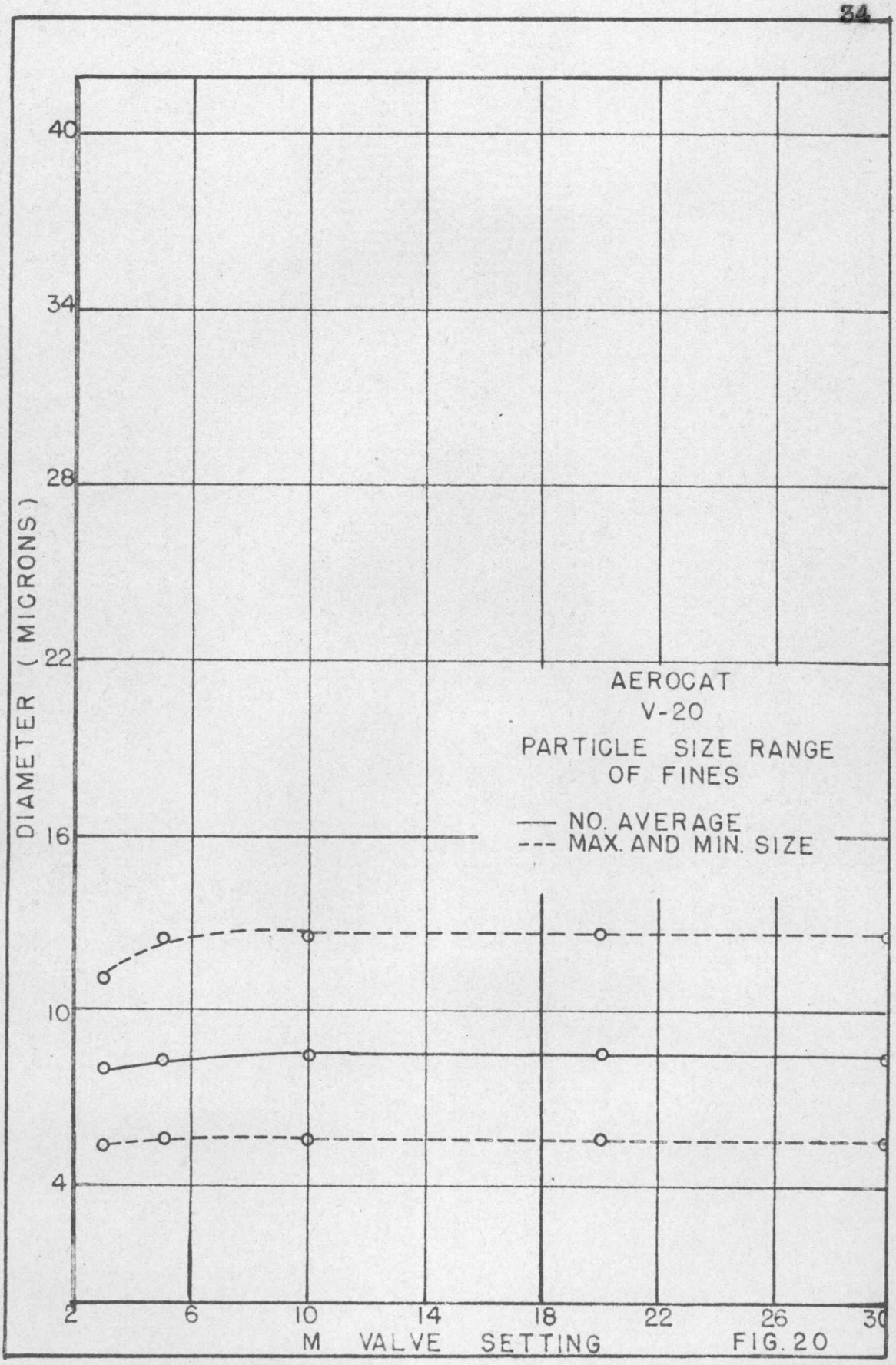
40
34
28
22
16
10
4
DIAMETER (MICRONS)
AEROCAT
V-20
PARTICLE SIZE RANGE
OF FINES
NO. AVERAGE
MAX. AND MIN. SIZE
2
6
10
14
18
22
26
30
M VALVE SETTING

FIG. 20

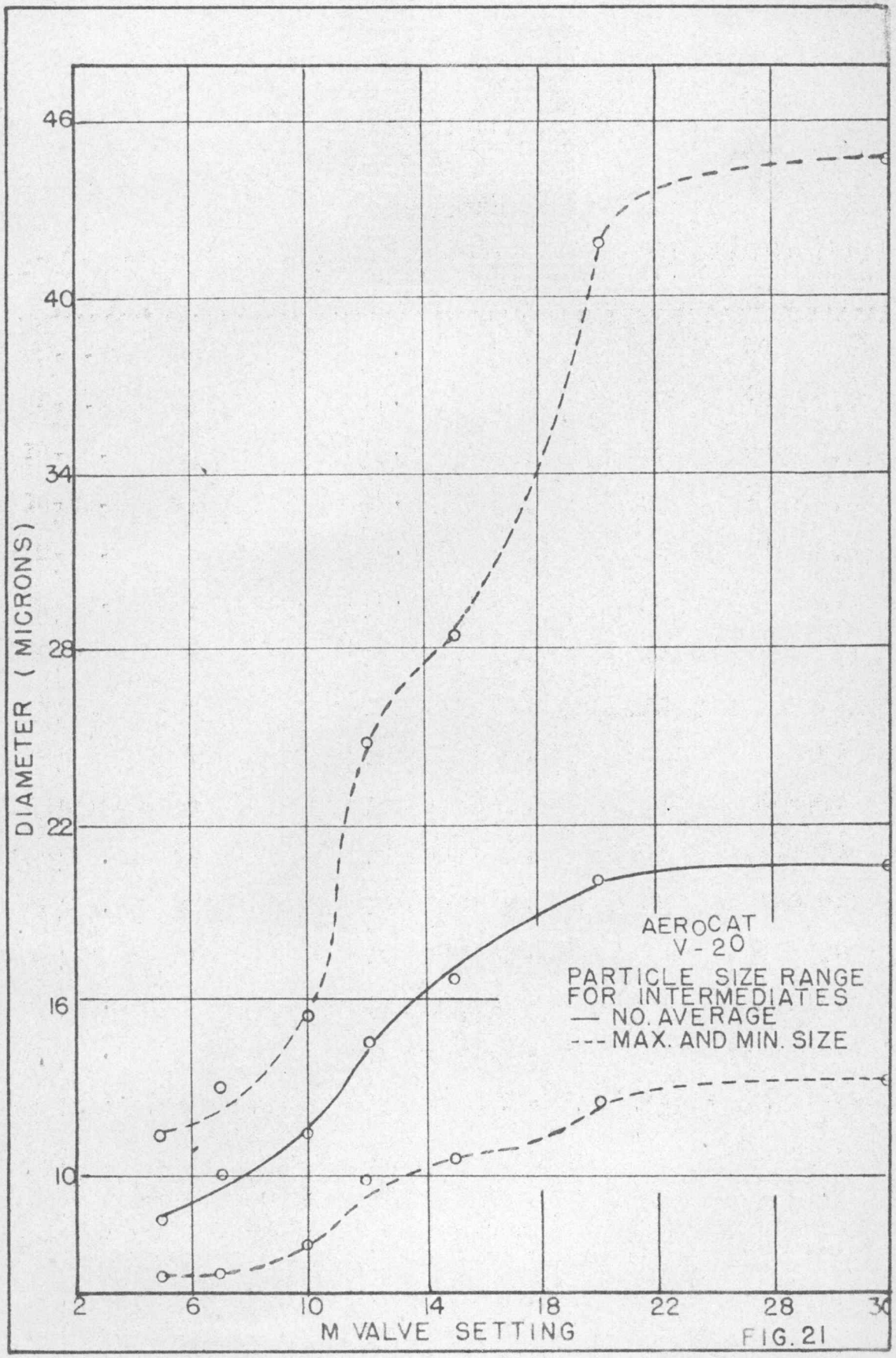
46
40
34
28
22
16
10
DIAMETER (MICRONS)
2
6
10
14
18
22
28
30
M VALVE SETTING
AEROCAT
V-20
PARTICLE SIZE RANGE
FOR INTERMEDIATES
— NO. AVERAGE
--- MAX. AND MIN. SIZE

FIG. 21

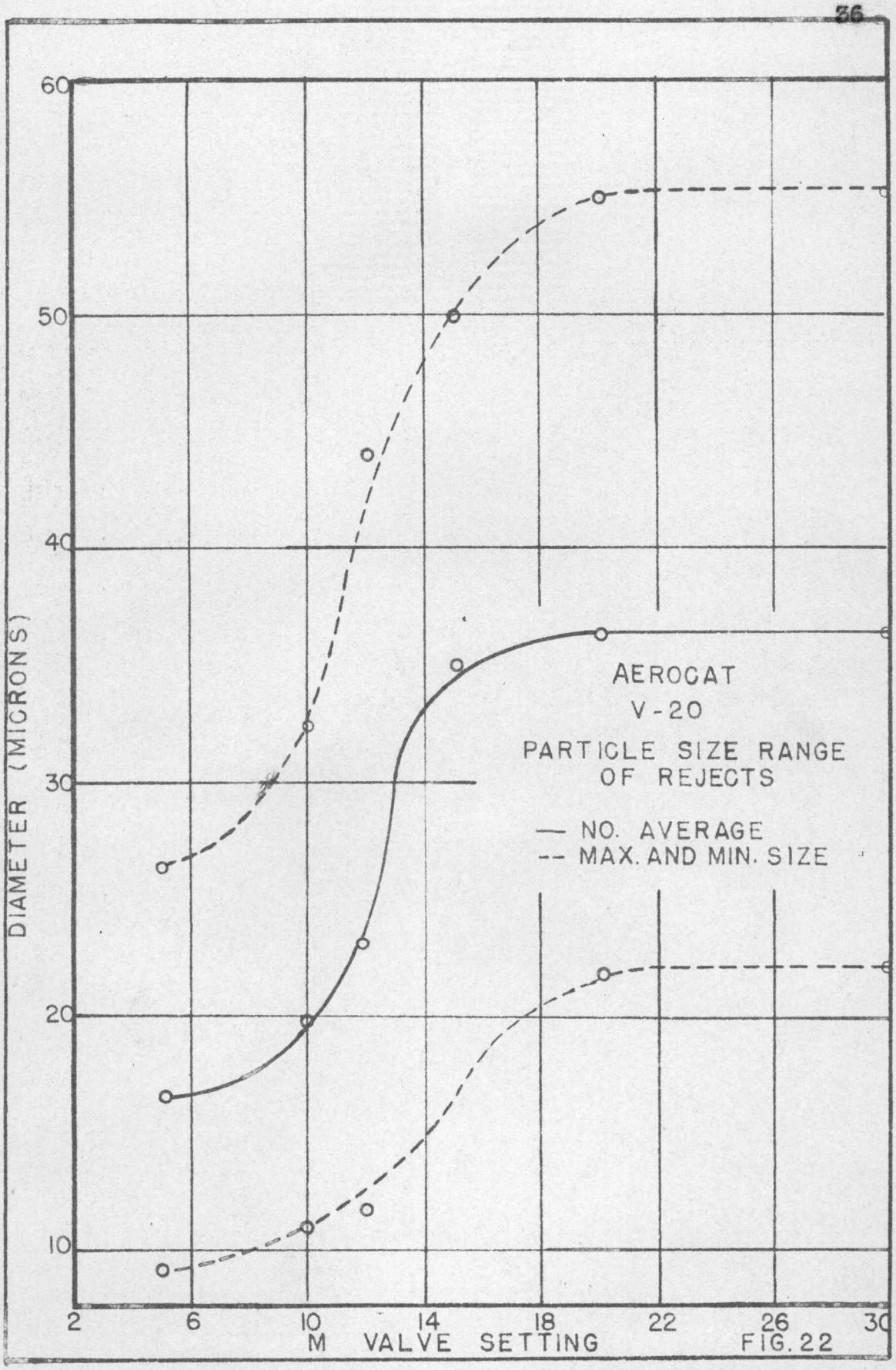
60
50
40
30
20
10
DIAMETER (MICRONS)
2
6
10
14
18
22
26
30
M VALVE SETTING
AEROCAT
V-20
PARTICLE SIZE RANGE
OF REJECTS
— NO. AVERAGE
-- MAX. AND MIN. SIZE

FIG. 22

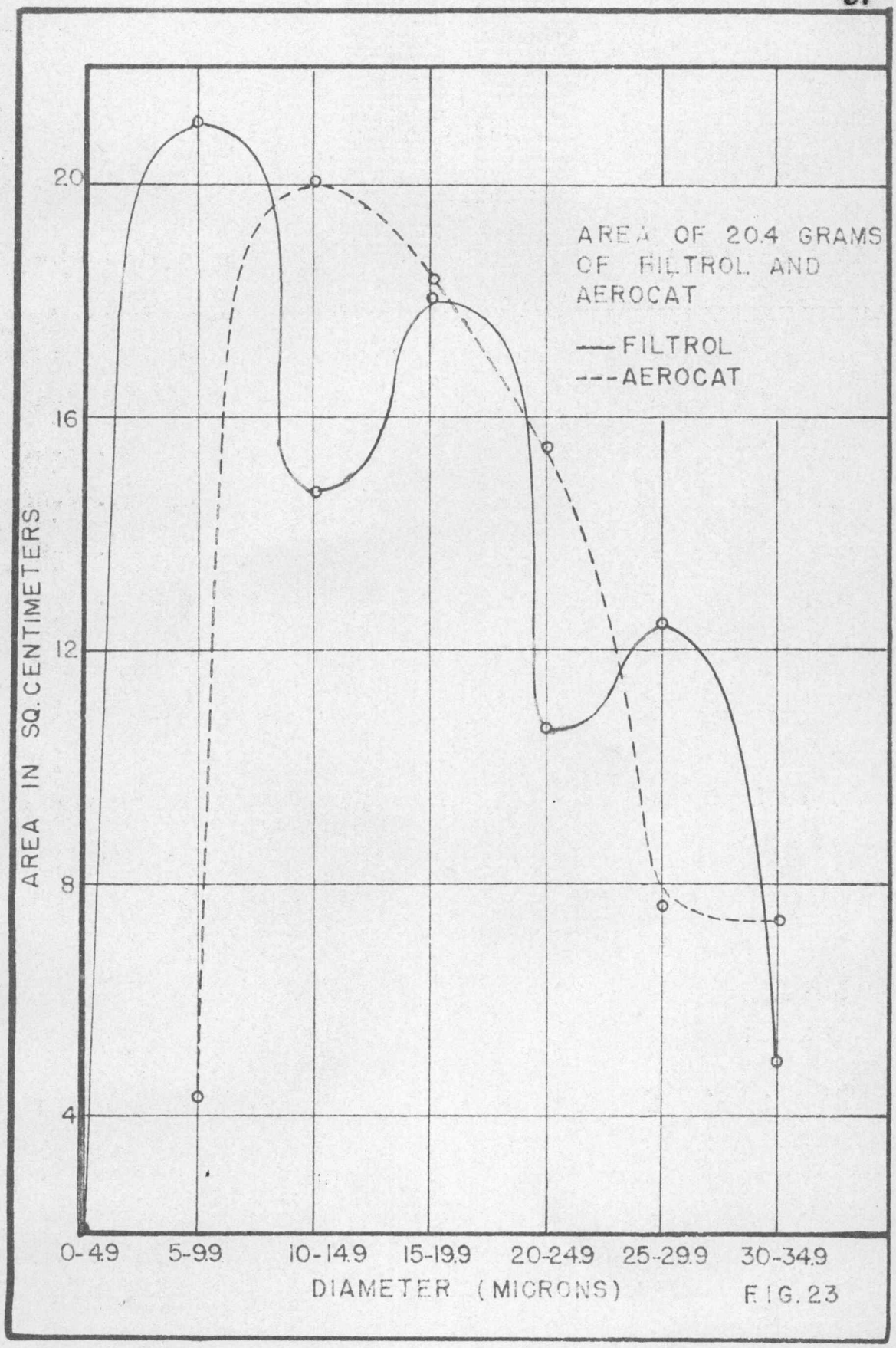
AREA OF 20.4 GRAMS OF FILTROL AND AEROCAT
—— FILTROL
--- AEROCAT
AREA IN SQ. CENTIMETERS
2.0
16
12
8
4
0-4.9
5-9.9
10-14.9
15-19.9
20-24.9
25-29.9
30-34.9
DIAMETER (MICRONS)

FIG. 23

FEDERAL AIR CLASSIFYING UNIT - B

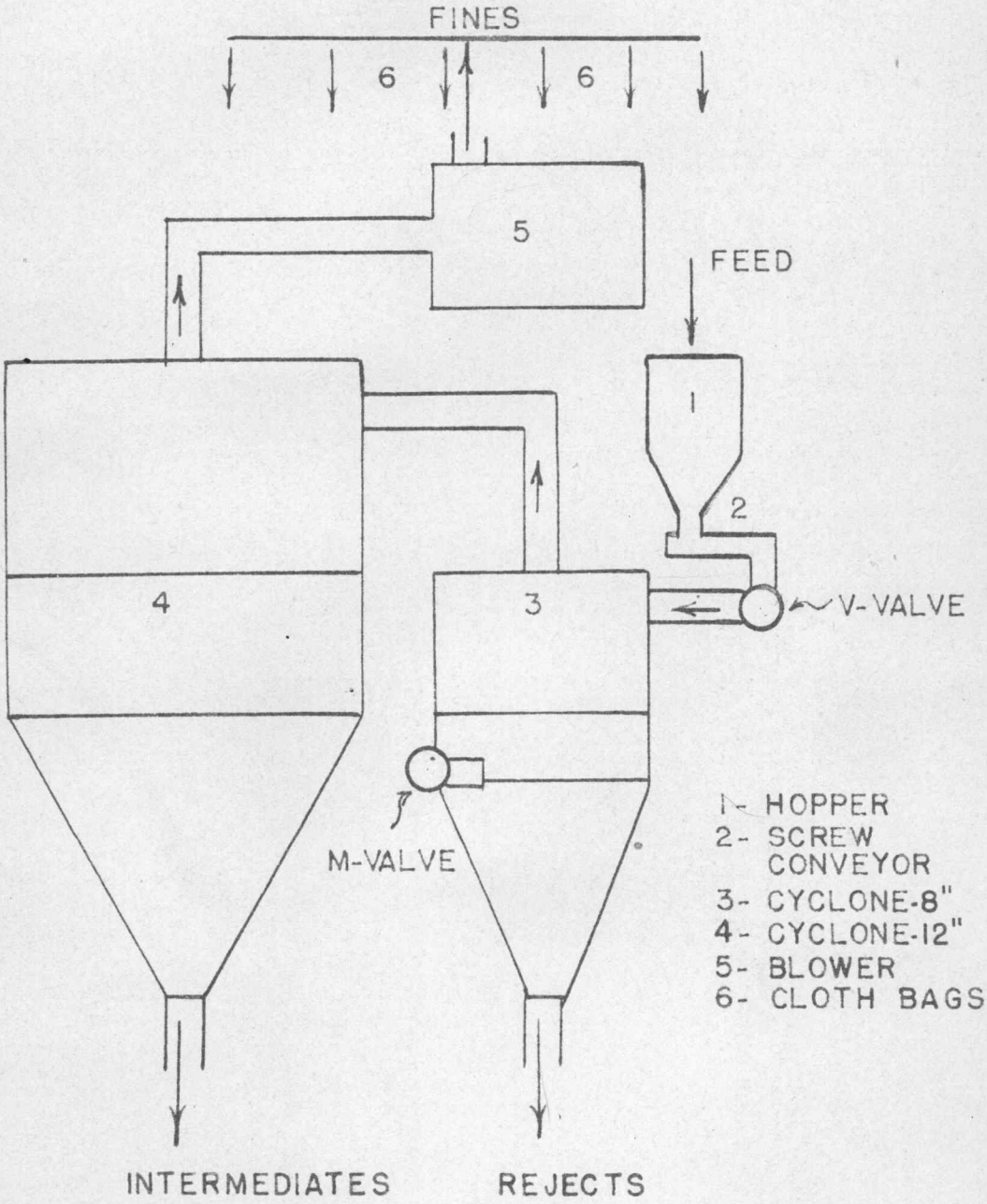

FIG. 24

TABLE 1

VELOMETER TYPE 2220 JET

V-15	READING
M-5	550
M-7	950
M-10	1350
M-12	1800
M-15	2200
M-11	2450
M-20	2700
M-25	2700
M-30	2700

BARO. 29.45 In. Hg

TEMP. 74°F

TABLE 2

RUN D-9

V-20, M-13 Wt. Sample 758.5 g Wt. Rejects 187.5 g

NO.	DIVISIONS	MICRONS	NO.	DIVISIONS	MICRONS
1.	150	32.9	21.	54	11.8
2.	50	11.0	22.	26	5.7
3.	78	17.1	23.	20	4.4
4.	62	13.6	24.	43	9.4
5.	50	11.0	25.	63	13.8
6.	41	9.0	26.	45	9.9
7.	27	5.9	27.	25	5.5
8.	23	5.1	28.	32	7.0
9.	48	10.5	29.	37	8.1
10.	50	11.0	30	47	10.3
11.	21	4.6	31.	15	3.3
12.	100	21.9	32.	40	8.8
13.	72	15.8	33.	19	4.2
14.	31	6.8	34.	22	4.8
15.	40	8.8	35.	57	12.5
16.	55	12.1	36.	58	12.7
17.	31	6.8	37.	30	6.6
18.	150	32.9	38.	40	8.8
19.	80	17.5	39.	25	5.5
20.	28	6.1	40.	24	5.3

TABLE 2 Cont.

RUN D-9

V-20, M-13 Wt. Sample 758.5 g Wt. Rejects 187.5 g

NO.	DIVISIONS	MICRONS	NO.	DIVISIONS	MICRONS
41.	75	16.5	62.	25	5.5
42.	44	9.7	63.	27	5.9
43.	38	8.3	64	27	5.9
44.	27	5.9	65.	72	15.8
45.	42	9.2	66.	22	4.8
46.	17	3.7	67.	30	6.6
47.	51	11.2	68.	32	7.0
48.	100	21.9	69.	41	9.0
49.	61	13.4	70.	32	7.0
50.	29	6.4	71.	50	11.0
51.	41	9.0	72.	51	11.2
52.	55	12.1	73.	37	8.1
53.	47	10.3	74.	25	5.5
54.	85	18.7	75.	55	12.1
55.	43	9.5	76.	30	6.6
56.	34	7.4	77.	70	15.4
57.	17	3.7	78.	39	8.6
58.	40	8.8	79.	23	5.1
59.	65	14.3	80.	47	10.3
60.	28	6.1	81.	49	10.7
61.	27	5.9	82.	21	4.6

TABLE 2 Cont.

RUN D-9

V-20, M-13 Wt. Sample 758.5 g Wt. Rejects 187.5 g

NO.	DIVISIONS	MICRONS	NO.	DIVISIONS	MICRONS
83.	26	5.7			
84.	22	4.8			
85.	22	4.8			
86.	40	8.8			
87.	39	8.6			
88.	100	21.9			
89.	32	7.0			
90.	67	14.6			
91.	55	12.1			
92.	43	9.5			
93.	18	4.0			
94.	50	5.5			
95.	19	4.2			
96.	55	12.1			
97.	35	7.7			
98.	20	4.4			
99.	50	11.0			
100.	30	6.6			

TABLE 3

RUN D-9

SIZE GROUP MICRONS	MEAN OF SIZE GROUP	NO. OF PARTICLES OF EACH SIZE
0-4.9	2.5	14
5-9.9	7.5	48
10-14.9	12.5	25
15-19.9	17.5	10
20-24.9	22.5	0
32.9	32.9	2

VALUE OF nxd	VALUE OF nd^3	VALUE OF nd^4
35	2180	5460
360	20200	156000
312.5	48800	610000
175.0	53500	935000
0	0	0
65.8	68600	2226000
948.3	193280	3932460

$D_{av.} = \frac{9.48}{100} = 9.48$ Microns $\quad D_{w.} = \frac{3,932,460}{193,280} = 20.4$ Microns

Dw. = weighted average diameter

Dav. = arithmetic average diameter

TABLE 4

MICROSCOPE CALIBRATION

Calibration of Filar Eyepiece for Magnification of 440 x.

	Micrometer Divisions	Equivalence
Trial (1)	228.0	Division = $\frac{50}{228.0}$ = 0.219 Microns
Trial (2)	227.5	Division = $\frac{50}{227.5}$ = 0.22 Microns
Trial (3)	227.0	Division = $\frac{50}{227.0}$ = 0.22 Microns
Trial (4)	227.0	Division = $\frac{50}{227.0}$ = 0.22 Microns
Trial (5)	228.0	Division = $\frac{50}{228.0}$ = 0.219 Microns

Total Microns = 1.098

One Division = $\frac{1.098}{5}$ = 0.2195 Microns

The above calibration was done with aid of standard scale with which the divisions to cross 5 divisions on the standard scale was the basis.

Division of Standard Scale = 0.01 MM. = 10 Microns

5 divisions = 0.05 MM. = 50 Microns

∴ One (1) division on Filar Eyepiece micrometer scale = 0.2195 microns, at 440 x.

TABLE 5

FILTROL

V	M	WT. SAMPLE GRAMS	NO. AVERAGE DIAMETER OF INTERMEDIATES	WT. TO BAGS GRAMS
5	5	182.5	8.44	30.5
"	10	685.0	12.40	21.0
"	15	677.0	12.60	28.5
"	20	660.0	11.60	30.0
"	25	662.5	11.94	24.0
"	30	677.0	11.80	34.5
10	5	95.0	6.15	15.0
"	6	135.0	6.105	33.5
"	6½	177.0	6.350	28.5
"	7	246.0	7.595	27.5
"	8½	380.5	9.050	30.5
"	9	534.5	10.425	25.5
"	10	719.5	11.43	31.0
15	5	11.0	5.1	44.0
"	6	18.5	5.4	46.5
"	7	74.5	5.45	37.5
"	8	158.0	7.225	26.0
"	9	195.0	7.42	35.5

TABLE 5 Cont.

FILTROL

V	M	WT. SAMPLE GRAMS	NO. AVERAGE DIAMETER OF INTERMEDIATES	WT. TO BAGS GRAMS
15	10	428.0	8.94	20.5
"	15	865.0	11.0	
"	20	895.5	11.6	
"	25	892.5	11.1	
20	5	10.5	3.4	42.0
"	6	20.0	4.50	44.0
"	7	32.0	4.95	61.0
"	8	101.5	6.05	27.0
"	9	169.0		48.5
"	10	200.0	7.05	58.5
"	11	248.5	7.30	54.5
"	12	550.5	8.80	57.5
"	13	758.5	9.48	54.0
"	15	819.0	9.80	50.0
"	20	920.0	11.23	63.0
25	5	14.5	4.44	35.0
"	6	20.5	4.50	44.0
"	7	32.5	4.95	46.5

TABLE 5 Cont.

FILTROL

V	M	WT. SAMPLE GRAMS	NO. AVERAGE DIAMETER OF INTERMEDIATES	WT. TO BAGS GRAMS
25	8	67.0	5.40	70.0
"	9	77.0	5.97	60.5
"	10	157.0	7.20	42.0
"	12	248.0	7.30	49.0
"	13	374.0	8.55	72.0
"	14	669.5	9.02	75.0
"	15	753.0	9.48	70.0
"	20	927.5	11.23	51.0
30	5	14.0	4.44	41.0
"	6	23.5	4.50	44.0
"	7	30.0	4.97	48.5
"	8	43.0	4.80	50.0
"	9	58.0	5.50	55.0
"	10	129.0	6.46	40.0
"	12	199.5	7.75	47.5
"	14	462.5	9.15	54.0
"	15	693.5	9.6	68.5
"	20	924.0	11.23	47.5

TABLE 6

AEROCAT

V	M	WT. SAMPLE GRAMS	NO. AVERAGE DIAMETER OF INTERMEDIATES	WT. TO BAGS GRAMS
5	3	43.0	11.9	6.5
"	5	119.0	12.95	11.0
"	7	401.0	16.10	8.0
"	10	683.0	18.00	19.0
"	15	679.0	17.32	21.0
"	20	672.0	17.32	21.0
"	30	698.0	18.00	27.0
10	3	10.0	8.40	15.5
"	5	70.0	11.43	15.0
"	10	499.0	14.97	14.5
"	15	824.0	19.50	15.0
"	20	826.0	19.50	14.5
15	5	14.0	9.25	1.0
"	7	42.5	11.10	24.5
"	10	394.0	15.30	13.0
"	12	610.0	16.60	11.0
"	15	783.5	18.40	9.5
"	20	878.0	20.0	21.5

TABLE 6 Cont.

AEROCAT

V	M	WT. SAMPLE GRAMS	NO. AVERAGE DIAMETER OF INTERMEDIATES	WT. TO BAGS GRAMS
20	5	9.0	8.5	7.5
"	7	29.0	10.0	6.0
"	10	221.0	11.42	10.5
"	12	548.0	14.70	2.0
"	15	766.5	16.65	15.5
"	20	935.0	20.02	13.5
25	5	9.5	8.5	6.5
"	7	30.0	9.5	6.5
"	10	81.0	11.5	11.5
"	12	228.0	15.99	10.0
"	15	761.0	17.40	15.5
"	20	916.0	20.00	14.0
30	5	11.0	8.6	6.0
"	7	22.0	9.15	7.0
"	10	98.5	12.50	12.0
"	13	302.5	15.80	21.5
"	15	675.0	17.30	22.5
"	20	862.0	20.0	15.0

BIBLIOGRAPHY

1. Dalla Valla, J. M., Micromeritics. Chicago, Pitman Publishing Corporation, 1943.

2. Dorr, J. V. N., Fine Grinding and Classification. Transactions American Institute of Mining and Metallurgical Engineers 112:161, 1934.

3. Federal Classifier Systems Inc. Chicago, Bulletin 30.

4. Shepperd, C. B. and Lapple, C. E. Flow Patterns and Pressure Drop in Cyclone Dust Collectors. Industrial Engineering Chemistry 31:972-84, Sept. 1939.