#1956 THE INSTITUTE OF PAPER CHEMISTRY
(Study of Coater)
Project Reports (6)

PROJECT REPORT FORM

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PROJECT NO. 1956
COOPERATOR I.F.C.
REPORT NO. 31
DATE September 4, 1959
NOTE BOOK 1819
PAGE 49 TO 60
SIGNED Wallace E. Voeks
Wallace E. Voeks

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USING THE AIR KNIFE AND TRAILING BLADE FOR DOUBLE COATING

INTRODUCTION

The coating stations of the Institute Experimental Coater have been assembled such that it is possible to apply coatings by several techniques on the same web during the same machine run. These trials cover a study of double coating using the trailing blade and the air knife.

A web was coated by the trailing blade technique on the Institute Experimental Coater. After the web passed through the trailing blade coating station it entered the air knife coating station where the second coating was applied to the undried trailing blade coating. The functioning of the coating stations was observed with respect to the mechanical capability of applying this double coating. A study of the appearance of the air knife coating over the trailing blade coating as well as coating weight studies were explored.

PROCEDURE

Coating formulation 1819-50-1 was a previously prepared formulation supplied for use in Special Number 11,077 trials conducted May 12 and 13, 1959. This formulation of 42.7% total solids was used for the air knife coating. The composition of this color is not known.

Coating formulation 1819-50-2 was prepared for use with the trailing blade coater and consisted of the following:

Material	Parts by Weight
"Premax" clay	50 lb.
Water	29 lb.
Quadrafos	70 g.
Rhoplex B-15	17.4 lb.
NH_4OH (to adjust pH to 8.0-8.2)	
Du Pont Soluble blue, Pb-6-D (DuP-45)	15 g.

The formulation was dispersed with a Model CV2 Lightnin' mixer and a 1/4 h.p. Homo-mixer. This formulation had a tendency to thicken considerably when it was not being mixed. Excess NH_4OH was added to give a pH of 9.4. The Du Pont soluble blue pigment was added to give this formulation a color for easier comparison of the trailing blade and air knife coating when applied to the same web. The total solids content of this formulation was 60.4%.

Viscosities, Brookfield Model LV

Formulation 1819-50-1		Formulation 1819-50-2	
	Spindle #1		Spindle #4
RPM	cp.	RPM	cp.
6	146	6	39800
12	102.5	12	32300
30	63.6	30	20000
60	48	60	10000

The base stock used was a cylinder kraft which was supplied for Special Number 11,077. This base stock has a caliper of approximately .024 inch and a basis weight of approximately 270 lb./ream (24X36--500). It was coated on the inside on the side with the smoother surface.

The machine threadup for trailing blade coating is illustrated in Figure 1. The machine threadup for air knife coating or the trailing blade-air knife combination double coating is illustrated in Figure 2. The rewind roll was used to pull the web through the coating system. The rewind speed was varied and settings are given in Table I. Trouble was encountered with previous runs using this board and attempting to rewind the web while wet. When the surface of the driving rolls of the rewind became wet, the rewound roll began slipping. To prevent this, one of the two driving rolls of the rewind stand was used as a center wind.

The blade extension length used for all trailing blade coating trials was 13/16 inch. About 47 p.s.i. air pressure was supplied to the 1-1/2-inch diameter pneumatic cylinder which forces the fountain against a stop and thus causes a controlled movement of the blade against the web supported by the breast roll.

The air knife nozzle opening was set at .030 inch. The distance between the nozzle and the breast roll was initially .100 inch. This distance was changed during the course of trials and settings are given in Table I. Air pressure supplied to the air knife was maintained at 1.5 p.s.i. The applicating or pan roll of the air knife coating station applied the coating by a kiss-type technique with the pan roll traveling in the web direction at a speed of 200 feet per minute. Rubber edge doctors were used on the pan roll.

The coating for the trailing blade fountain was recirculated although the duration of a machine run was so short that recirculation was probably not

Figure 1

Machine Threadup for Run 1919-57-1

THE INSTITUTE OF PAPER CHEMISTRY EXPERIMENTAL COATER

Assembly of Coaters

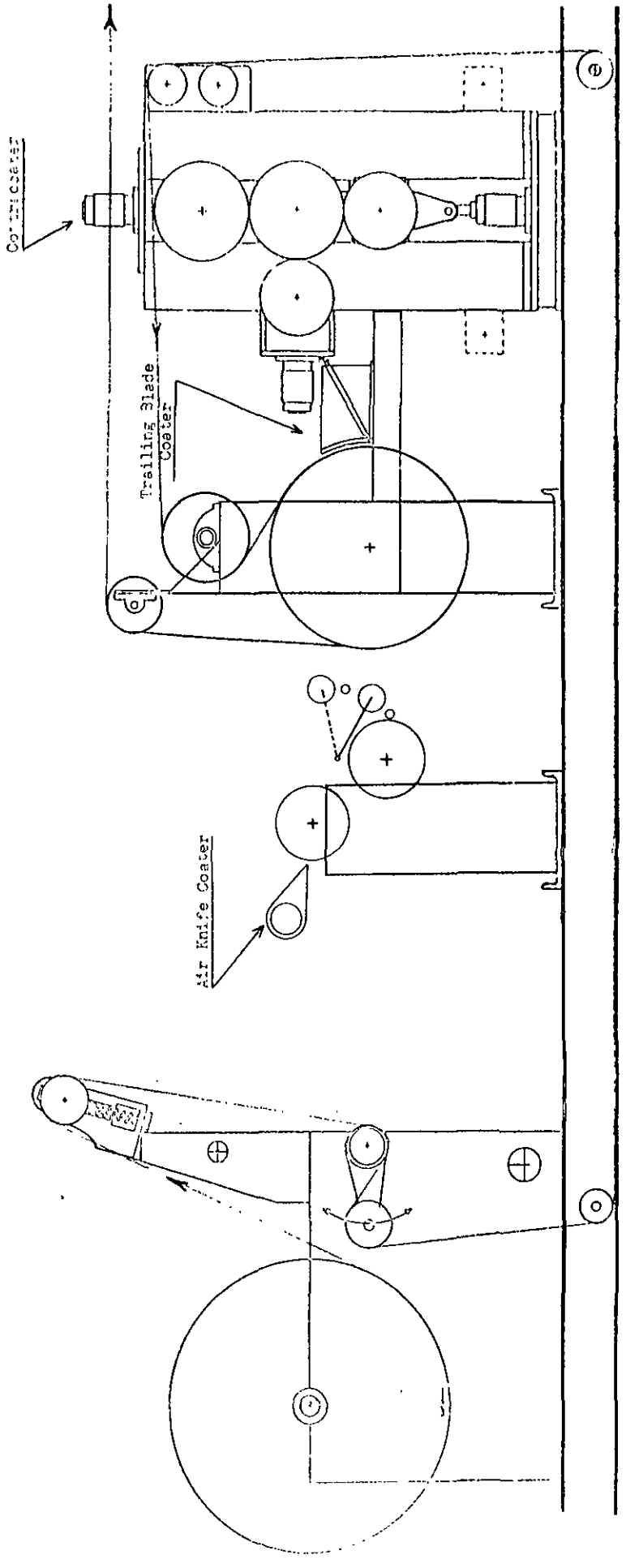


Figure 2

Machine Threadup for Runs 1919-57-2 through 1919-57-5

THE INSTITUTE OF PAPER CHEMISTRY EXPERIMENTAL COATER

Assembly of Coaters

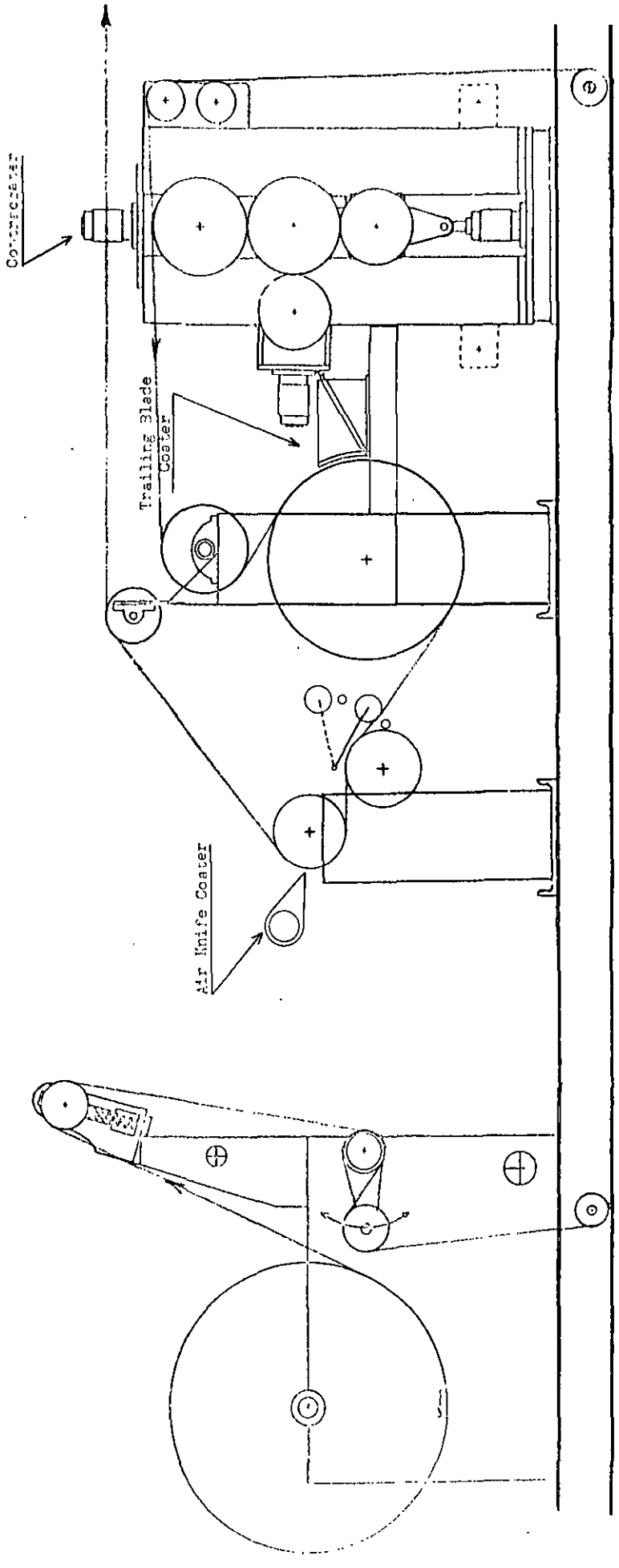


TABLE I

COATING TRIALS WITH THE TRAILING BLADE AND AIR KNIFE

Run No.	Type Coating	Web Speed, ft./min.	Distance Air Knife Nozzle-to-Breast roll, inch	Coating Weight,[1] lb./24X36--500
1819-57-1	Trailing Blade	600	--	3.1
1819-57-2	Trailing Blade and Air Knife	600	.100	15.4
1819-57-3	Air Knife	600	.100	12.9
1819-57-4	Air Knife	600	.135	14.4
1819-57-5	Kiss roll	400	--	48.1

Notes:

[1]The coating weights were determined by ashing samples in a Lindberg muffle furnace for two hours at 1700°F.

The coating formulations and the raw stock were ashed similarly for use as controls.

necessary. The color was pumped out of the fountain with a 3/4 inch Jabsco pump coupled to a 1/4 h.p. Dynamic Division Ajusto-Spede electric motor with a 5-1 gear reducer. The color was pumped into a 25-gallon capacity tank using a Viking Model EFRC-2 pump coupled to a 1/3 h.p., 1725 r.p.m. Leland electric motor. The coating for the air knife coating station was not recirculated.

The sequence of operation for a single coating using the trailing blade was as follows:

1. The rewind was started and the speed increased to the desired setting.
2. The trailing blade was moved to the closed position. (This may be done before the desired speed is attained to conserve base stock.)
3. The coating began by starting the recirculation system which supplied the coating to the trailing blade fountain.

The sequence of operation for a single coating using the air knife was as follows:

1. The color was added to the pan and the pan roll started.
2. The rewind was started.
3. The air knife blower was started.
4. The web was lowered to contact the pan roll. (To conserve coating formulation the web may not be lowered until desired speeds are attained.)

The sequence of operation for a double coating using the trailing blade and air knife was as follows:

1. The color was added to the air knife color pan and the pan roll started.
2. The rewind was started.
3. The trailing blade was moved to the closed position.
4. The air knife blower was started.
5. The trailing blade coating was started by starting recirculation.
6. The air knife coating was started by lowering the carrier roll to bring the web in contact with the pan roll.

RESULTS AND DISCUSSIONS

Run 1819-57-1: The machine threadup is shown in Figure 1. The coating applied by the trailing blade appeared very even and uniform and dried well enough to permit collecting the samples from the surface rewound roll. The infrared driers were at their maximum temperature settings and at a distance of twelve inches apart.

Run 1819-57-2, 1819-57-3, 1819-57-4: The machine threadup is shown in Figure 2. The pan roll of the air knife coating station was not traveling at a fast enough rate of speed to apply an even coating to the web at speeds of 600 feet per minute. There were skip marks present every 20-24 inches. This coating was not dried and a center rewind technique was used. Samples were collected by breaking the web while the machine was in operation.

Run 1819-57-5: The machine threadup is shown in Figure 2. At the web speed of 400 feet per minute sufficient coating was applied to correct the skip marks present when applying the coating at a web speed of 600 feet per minute. The air knife was not used. The coating was not dry and a

center rewind technique was used. Samples were collected by breaking the web while the machine was in operation.

It was found from previous experience that a more even coating is obtained in some kiss-type applications if the applicating roll is traveling in the opposite direction to the web. The pan roll in these trials was traveling in the same direction as the web and there was evidence of an application pattern in the run (1819-57-5) where no air knife was used.

The color pan, when in position under the pan roll, has a capacity of about 2-1/4 quarts of color of which one quart is required to bring the color level up to transferring conditions. This allows only about 100-200 feet of web to be coated without further addition of color. At high speeds the coating was pumped out of the color pan by the action of the roll and edge doctors. A larger color pan is being made for future tests at higher speeds.

The amount of web that could be center wound on one driving roll before binding against the other driving roll of the rewind limited the length of run to less than 150 feet. A center wind with means to keep the speed constant or vastly increased drying capacity seems desirable if we are to do much coating on board.

The coating weight of the double coating compares closely to the sum of the trailing blade single coating weight and the air knife single coating weight.

The carrier roll is depressed to place the web in contact with the air knife pan roll. There are no graduations or reference marks to insure that the carrier roll is at the same position for all runs. It may be desirable to mark the carrier roll positions for various degrees of web "wrap" on the roll.

The Du Pont soluble blue pigment used to try to color the trailing blade coating did not show up as desired. An insufficient amount of the pigment was apparently added since the blue color of the coating would disappear after considerable mixing.

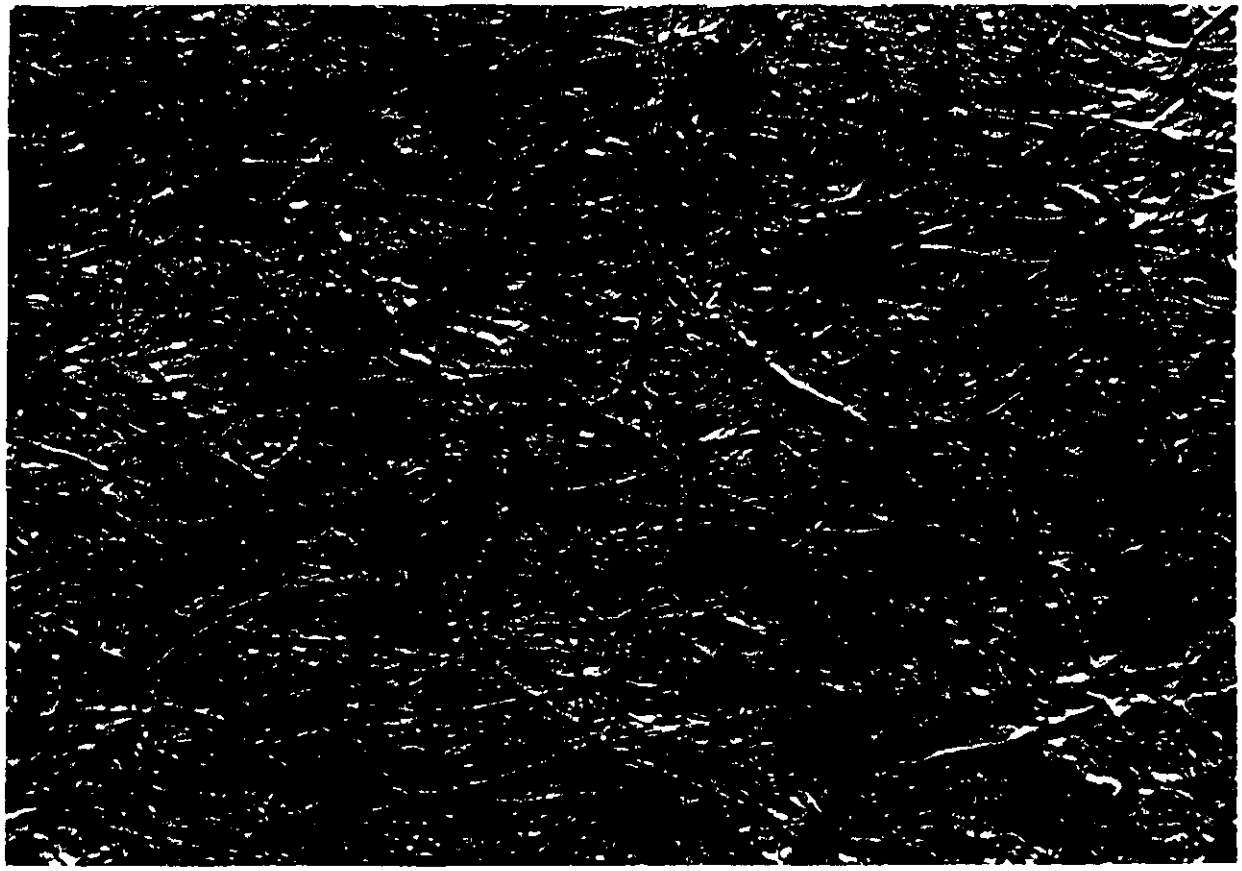
Samples of the machine runs are filed in the Special Processes Section "Machine Trials" file.

Samples of runs 1819-57-1, 1819-57-2, and 1819-57-3 were submitted through the Code Office for illumination pictures. The photomicrographs were prepared at a magnification of 20X and using a 5° grazing angle of illumination with the illumination perpendicular to the machine direction of the coated board. Prints of the photomicrographs for runs 1819-57-1, 1819-57-2, 1819-57-3, and a sample of raw stock are attached as Figures 3, 4, 5, and 6, respectively.

wev/bl

Figure 3

5° Illumination Photomicrograph

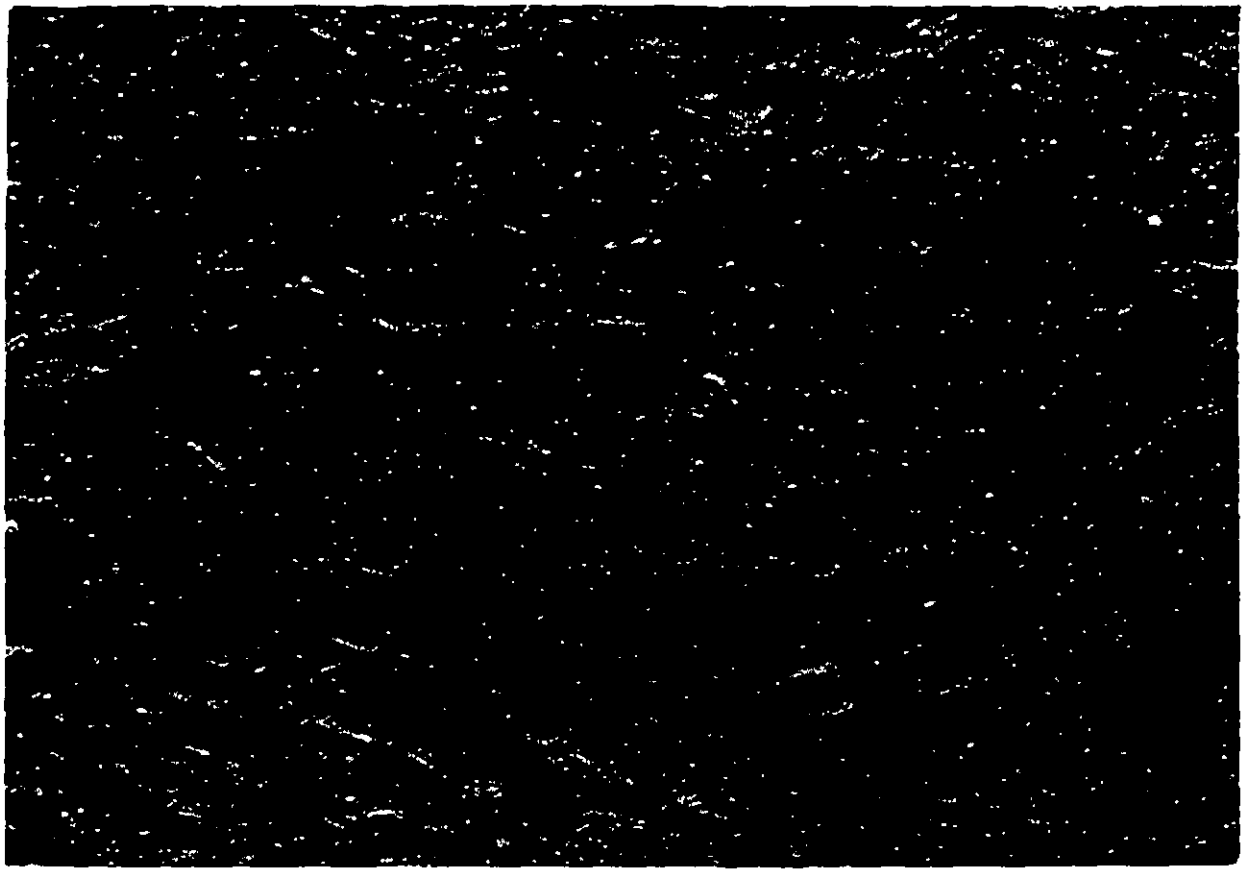


Trailing Blade Coated Board

Sample 1919-57-1

Figure 4

5° Illumination Photomicrograph

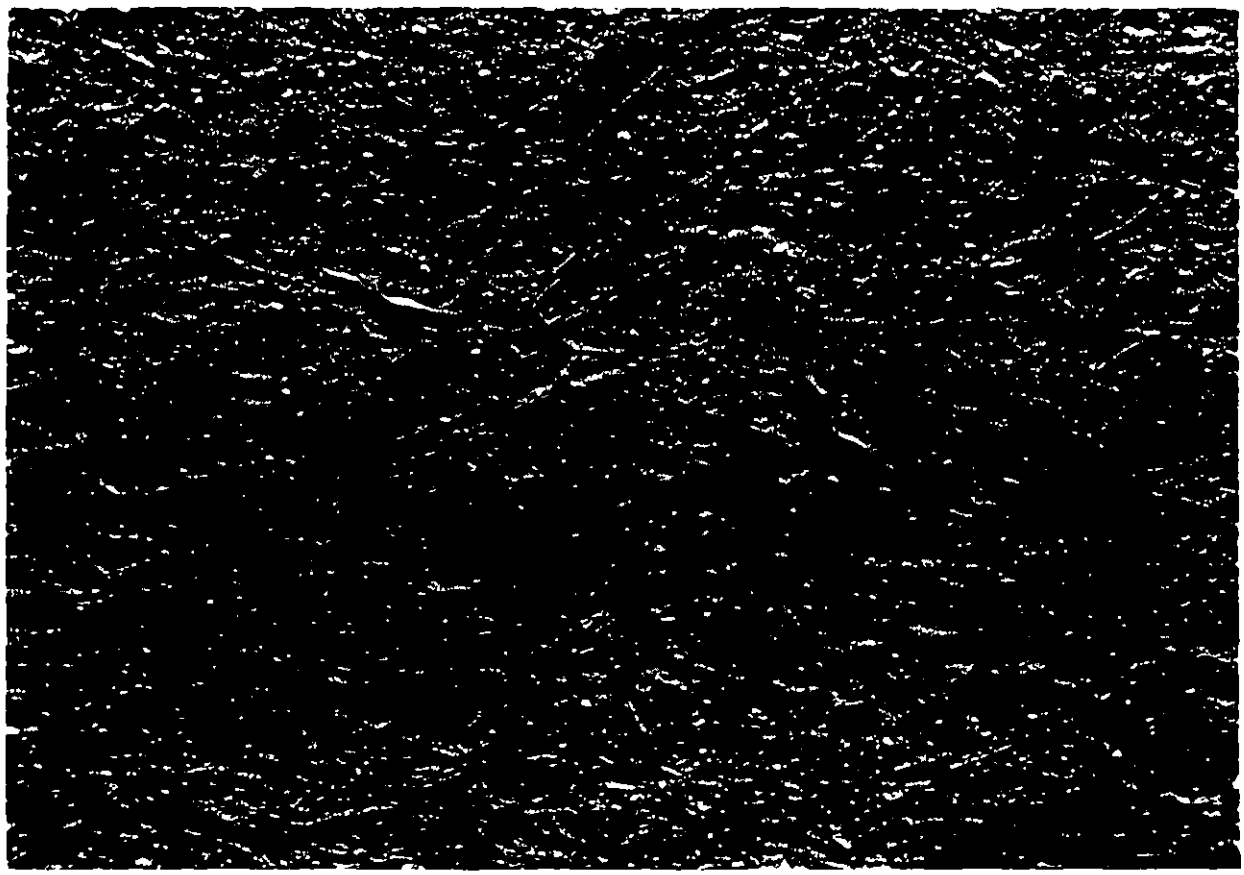


Trailing Blade - Air Knife Coated Board

Sample 1919-57-2

Figure 5

5° Illumination Photomicrograph

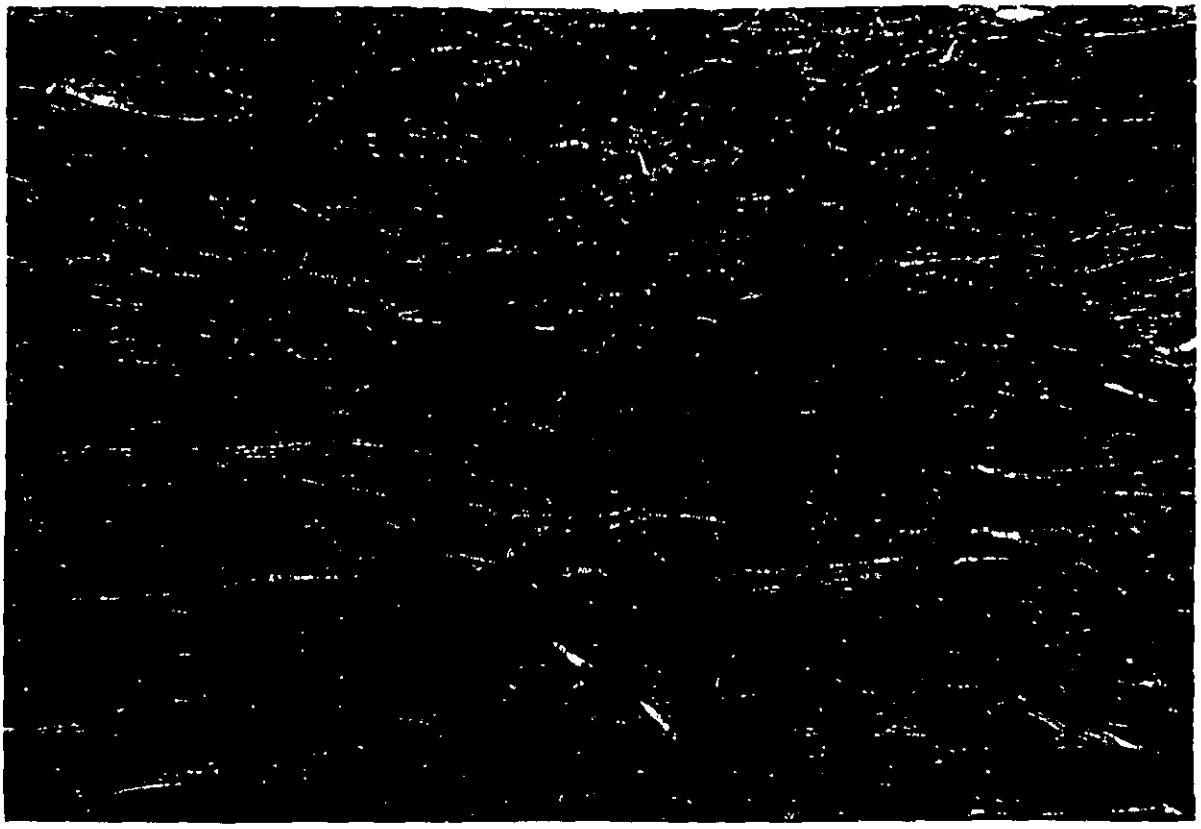


Air Knife Coated Board

Sample 1919-57-3

Figure 6

5° Illumination Photomicrograph



Raw Stock

PROJECT REPORT FORM

PROJECT NO. 1956
COOPERATOR I. P. C.
REPORT NO. 32
DATE December 29, 1959
NOTE BOOK
PAGE TO
SIGNED T. A. Howells
T. A. Howells

Copy to: Files
Dr. Howells
Mr. Vaurio

INTRODUCTION

On November 12, 1959, The Appleton Coated Paper Co. started some additional trials with high speed coating. They are considering the purchase of a production coater for a specific product and are faced with a choice between a coating line designed for a maximum speed of 1000 f.p.m. or one designed for 2000 f.p.m. It seems generally agreed in the industry that air knife coating is limited to a speed of approximately 1000 f.p.m. Since they expect the cost of the higher speed unit to be considerably greater than that of the one designed for 1000 f.p.m., they would like some assurance that they will be able to coat at speeds considerably above 1000 f.p.m., to justify the purchase of the more expensive equipment. These trials were aimed at a brief investigation of this possibility.

HIGH SPEED COATING TRIALS

Coating color was furnished by The Appleton Coated Paper Co. and taken from their regular production supply (designated as NCR Emulsion, modified, 38% floc). Coatings were made on the wire side of the 46 lb. Nekoosa paper which was on hand. Most coating was done with a complete reverse roll operation ("Contracoater"), in one case bringing the paper directly over the rubber roll and through the drier, and in the other case carrying the web from the coating nip, around the breast roll of the air knife, then over two smoothing rolls which were operated against the direction of travel of the paper. Initial conditions were based on promising results obtained two years ago at a maximum speed of 1000 f.p.m.

Coating conditions are shown in Table I. The first trial had inadequate coating weight and the second trial was modified by opening the metering roll nip. Since unsatisfactory coating distribution resulted, the conditions were then reset to those previously utilized at a speed of 1000 f.p.m. Fairly good coating resulted, but at excessive coating weight. Coating weight was reduced by adjustment of the metering roll gap (runs 4 and 5) and then the web speed was increased without further adjustment of coating conditions (runs 6 and 7). At this point, it appeared justifiable to start the use of smoothing rolls and this was done in runs 8, 9, and 10. At this coating weight and these conditions, there was no throwing of color from the smoothing rolls, even at a peripheral speed of 1650 f.p.m. (All samples were grab samples obtained after very short run periods.)

Trials were interrupted over the week end. When they were resumed on November 17 after a discussion of the results to date, web speed was set at 2000 f.p.m. in an effort to obtain good coating at this speed. In the process of adjusting the rolls for good pattern appearance before attempting to coat a web, starvation in the nip between the applicator and pan rolls was noticed. Various adjustments of the pan roll speed and nip were attempted without appreciable benefit on the streakiness of coating. Polyco was then added to raise the viscosity of the color from 45 centipoises to 195 centipoises and runs 11 through 14 were made without encouraging results.

On December 1, The Appleton Coated Paper Co. returned to demonstrate to Mr. Lewenstein coating behavior under the conditions used for run 8. A first trial yielded a coating weight of 2.8, but a subsequent test without changing conditions showed a coating weight of 4.1 lb. (run 15).

TABLE I

ATTEMPTS TO COAT SPECIAL EMULSION AT HIGH SPEED

Run No.	Date	Speeds, f.p.m.					Gaps, inches			Coat Weight lb./3300 sq. ft.	Remar
		Web	Transfer Roll	Meter Roll	Pan Roll	Smoothing Roll	Meter	Pick-up	Pressure		
1	11/12	2000	2280	1560	115	--	.004	.010	.003	2.71	-
2	11/12	2000	2280	1560	115	--	.006	.010	.003	4.75	-
3	11/12	1058	1125	545	217	--	.006	.010	.003	12	-
4	11/13	1058	1125	545	217	--	.004	.010	.003	4.25	1
5	11/13	1058	1125	545	217	--	.005	.010	.003	10.25	2
6	11/13	1600	1125	545	217	--	.005	.010	.003	7.8	-
7	11/13	1800	1125	545	217	--	.005	.010	.003	5.2	-
8	11/13	1800	1125	545	217	1375	.005	.010	.003	4.8	3
9	11/13	1800	1125	545	217	340	.005	.010	.003	4.6	4
10	11/13	1800	1125	545	217	1650	.005	.010	.003	4.25	5
11	11/17	2000	1200	700	320	1600	.009	.010	.003	9	6
12	11/17	2000	1200	700	320	1600	.005	.010	.003	2	6
13	11/17	2000	1200	700	320	--	.007	.010	.003	6	6
14	11/17	2000	1200	700	320	1200	.007	.010	.003	7	6
15	12/1	1800	1125	545	217	1375	.005	.010	.003	4.1	-
16	12/1	1800	1125	545	217	1375	.006	.010	.003	5.8	7
17	12/1	1800	1125	545	217	1375	.006	.010	.003	4.1	8
18	12/1	1800	1125	545	217	1375	.007	.010	.003	8.2	9

Remarks:

1. No smoothing rolls - very little sample - web roll down.
2. Web roll down - no smoothing roll.
3. Smoothing rolls on 1375 f.p.m. - no throwing of color.
4. No throwing of color.
5. No throwing of color at 1650 f.p.m. - 1/4 inch wrap.
6. 3/8 inch wrap.
   On run 11 on, starvation in nip between applicator and pan rolls. Low viscosity of coating does not allow a good bead to form in nip. May be cause for streaks. Close nip down to .008. Added polyco to raise viscosity from 45 cp. to 195 cp. Rings become less noticeable as smoothing roll speed decreased.
7. Start-up satisfactory but coat weight suddenly increased, starting to throw color.
8. After mixing color in pan.
9. Air pressure on meter roll increased; spray began to develop.

In run 16, the metering roll gap was increased to .006 and these conditions permitted a satisfactory start-up, but apparently the coating weight then increased suddenly, causing serious throwing of color. Samples from this run showed a coating weight of 5.8 lb., suggesting that coating weight would be very critical in determining whether or not coating would be thrown by the smoothing rolls. However, it appeared probable that the coating had settled in the pan, allowing a lower solids content and possibly this dry coating weight represented a higher-than-normal wet coating weight. After mixing the color thoroughly, another run (No. 17) was made and a coating weight of 4.1 lb. resulted. The metering roll gap was then increased to .007 but streaks and serious throwing of color resulted and no samples were taken.

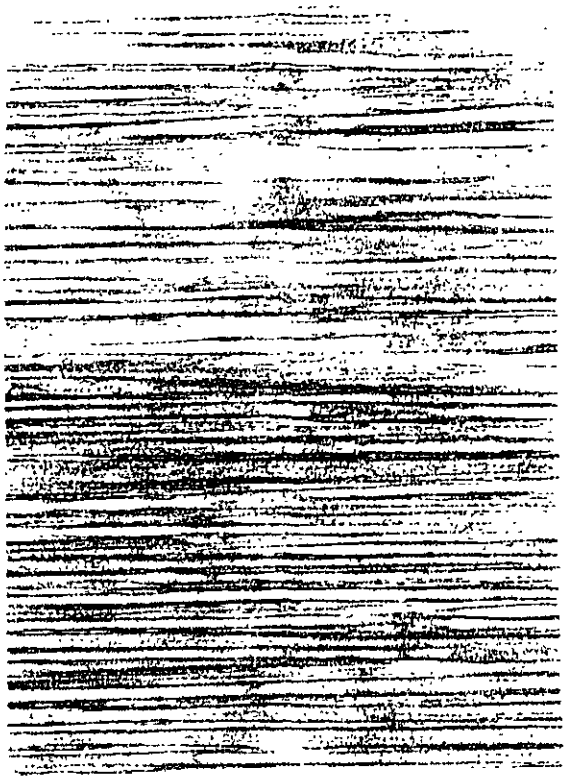
It appeared that some instability was present, permitting a satisfactory start-up but with a sudden lack of control causing excessive throwing of color. One suggestion was that the hydraulic pressure in the nip caused the nip to open under continued build-up. To check this effect, the air pressure on the metering roll nip was increased from approximately 40 to 70 p.s.i. Further discussion indicated the desirability of trying a reverse direction on the pan roll; this change was also made without a specific trial on the effect of the increase in air pressure. Under these conditions, however, the rolls also threw color and streaks appeared on the pan roll after the pan roll nip was closed in order to initiate coating. These streaks had not been present when the pan roll was turning in the coating color with an open nip. Mr. Lewenstein stated that he had never seen this effect before (where a roll passing through a pan of color would emerge from the pan without being completely covered).

The pan roll was then reversed again (using the original contracoater operation) and run no. 18 was made. Streaks were still apparent on the pan roll and spray began to develop on the smoothing rolls. Coating weight was found to be 8.2 lb. and work was discontinued at that time.

SUPPLEMENTARY TEST

Two days later I placed some of the same color into the coater and, using the same machine settings, but without any paper on the machine and with the web roll nip open, attempted to duplicate the streaking effects which had been obtained on the pan roll. With the pan roll running clockwise (feeding in with the applicator roll), a fairly smooth flood of color was carried up by the roll, but with three to five soft waves in it. With the nip closed, the rising side of the roll was covered by a flood of color rejected by the nip. The applicator roll and the pan roll were covered with ribs of coating approximately 1/4 inch apart on the exit side of the nip and a few bare streaks showed on the applicator roll, even after passing through the metering roll nip. When the pan roll was driven in the conventional contracoater direction (counter-clockwise) the color was carried on the roll in a manner comparable to that for the reverse direction, but when the nip was closed, the nip appeared starved with ribs about 1/2 inch apart and the applicator roll showing a few "flashes" or bare streaks. At this point, the pan roll was immersed only about 3/8 inch. When color was added to the pan so that the roll had about 1-inch immersion, the nip appeared much smoother with only an occasional "dimple". There was very little spray thrown by the metering roll, but a good flood of color

came off the doctor on the metering roll. These results indicated that the level of color may be critical in contracoater operation at these speeds, but that the amount of color returned by the applicator roll to the pan roll nip apparently was sufficient to prevent duplication of the effects observed when coating at high speed. Tests made by the Physical Chemistry group on a sample of this same coating color indicated it to have a viscosity of 18.8 centipoises at 1150 r.p.m. on the Hercules Viscometer and to behave in a manner as close to Newtonian as any materials they test.



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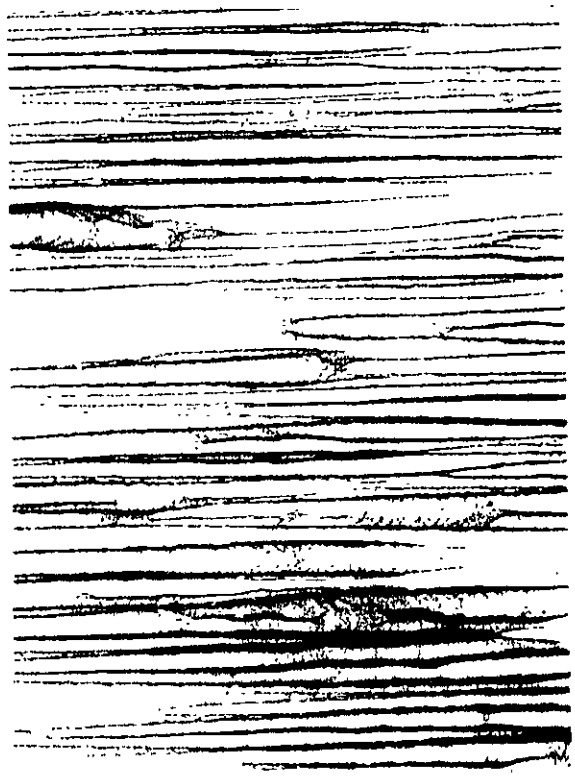

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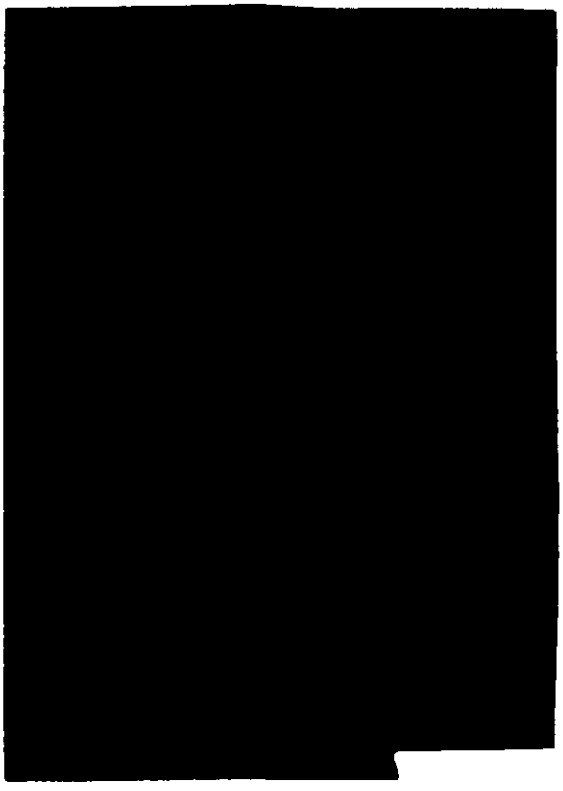

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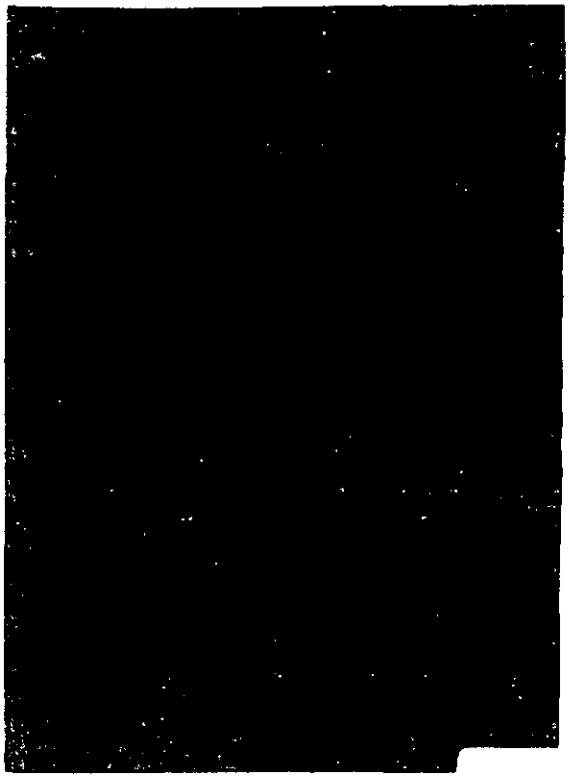

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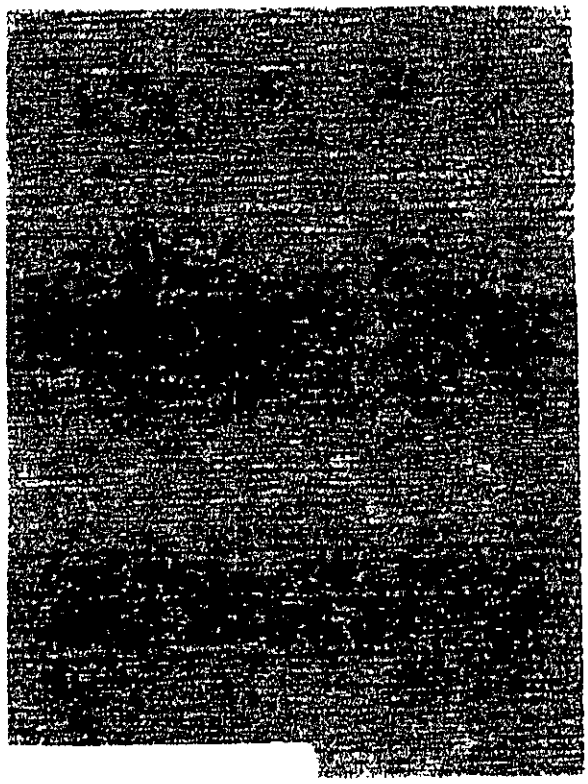

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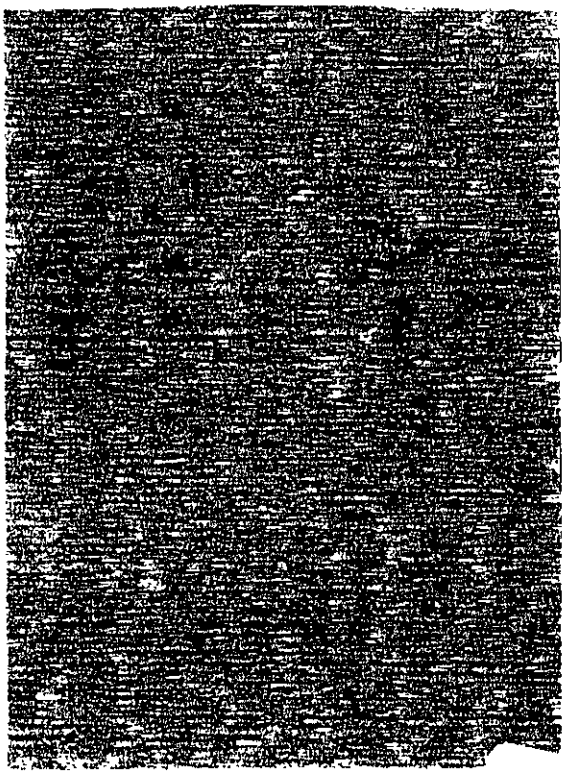

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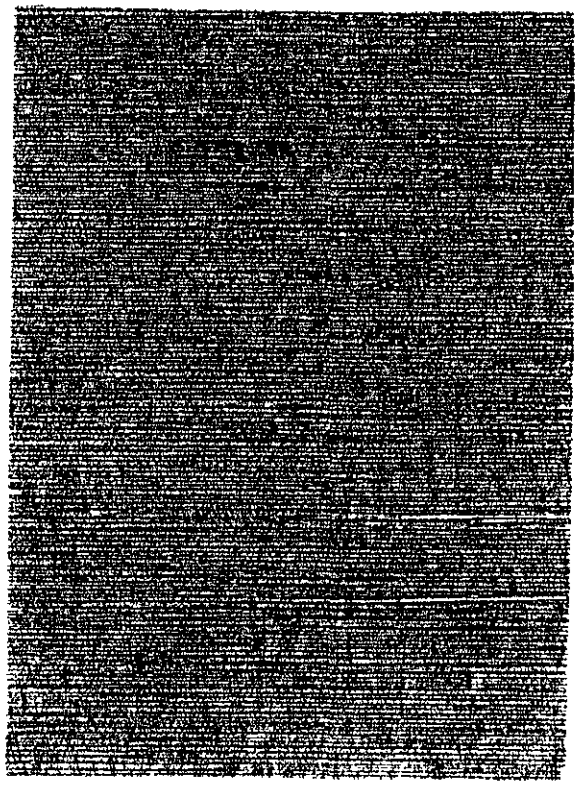

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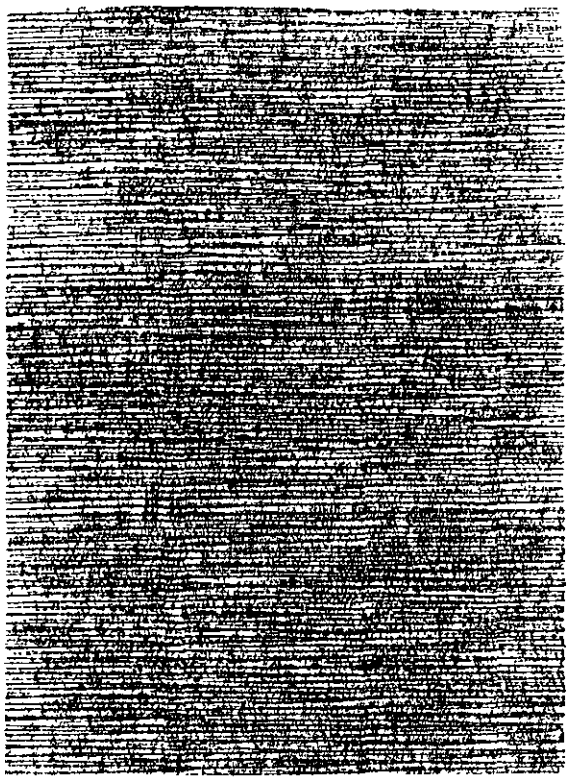

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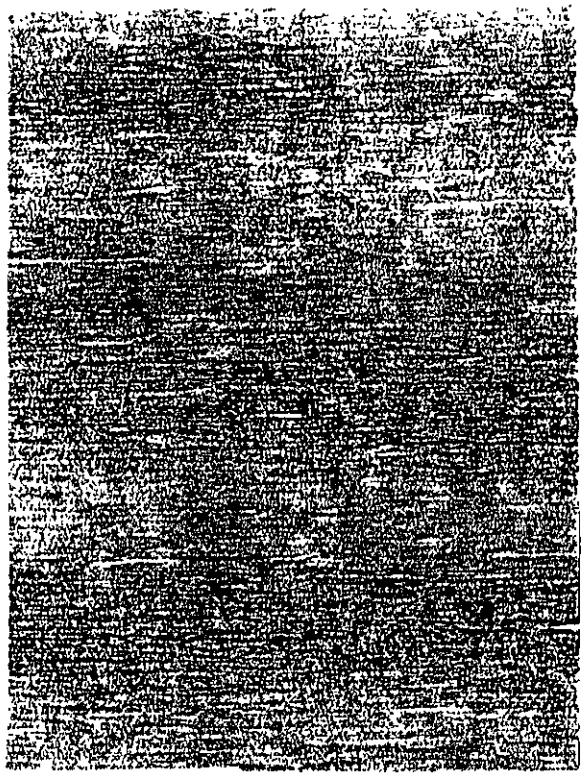

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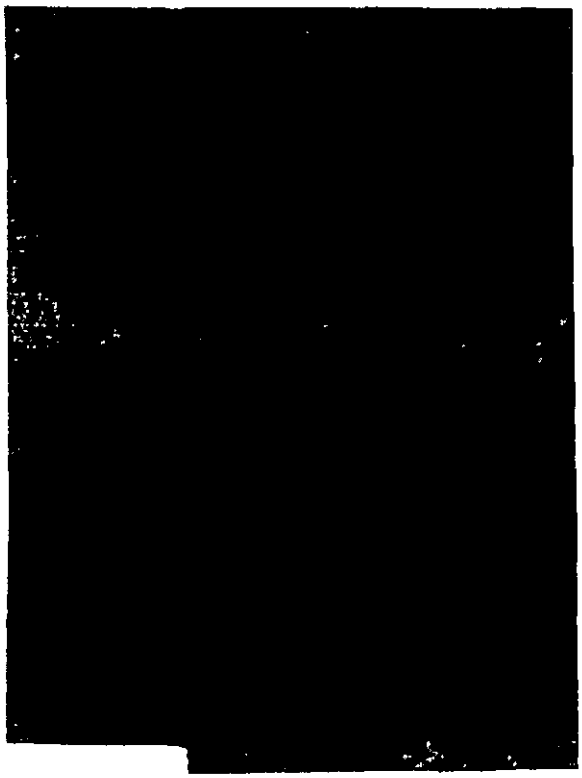

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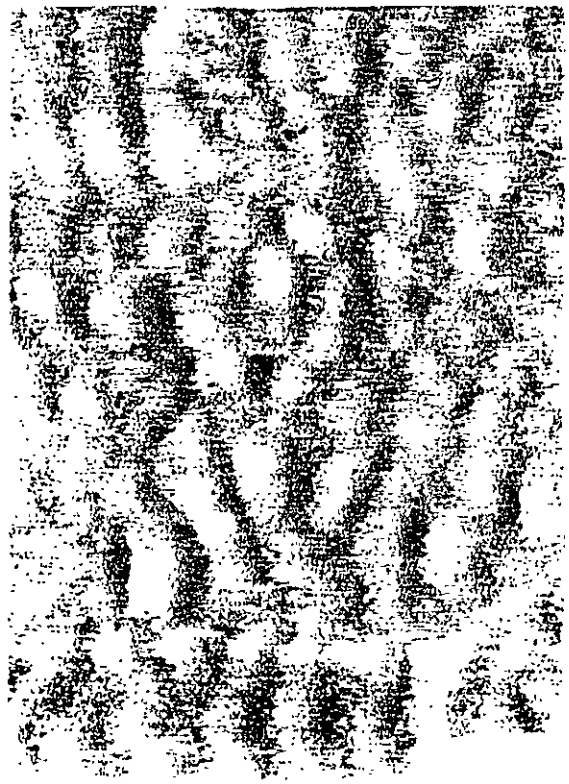

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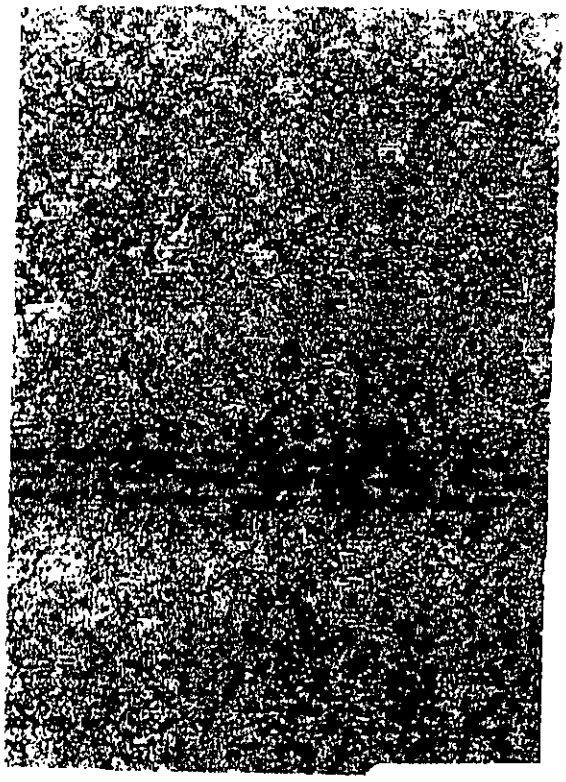

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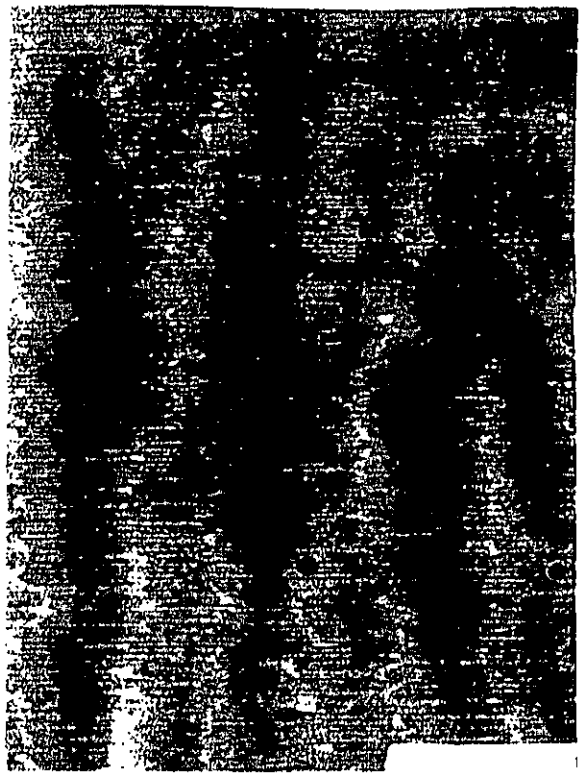

Run 14

PROJECT REPORT FORM

PROJECT NO. 1956
COOPERATOR I.P.C.
REPORT NO. 33
DATE February 10, 1960
NOTE BOOK
PAGE TO
SIGNED Wallace E. Voeks
Wallace E. Voeks

Frans Vaurio
Frans Vaurio

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Dr. Howells
Mr. Vaurio
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CONTRACOATER AND AIR KNIFE COATING OF NCR PAPER

INTRODUCTION

On September 8, 9, and 10, 1959, The Appleton Coated Paper Co. ran experiments with the Institute Experimental Coater and air knife attachment under Special No. 10,820.

PROCEDURE

The base stock used in the trials was a Nekoosa Book grade paper with pattern "OUR OR 68039." The basis weight is approximately 46 lb./25X36-500. The base stock was coated on the wire side for all trials except for the last three Contracoater runs (runs 10,820-17, 10,820-18, and 10,820-19). The NCR emulsion contained 18% total solids and had a viscosity of about 200 cp. at 50 r.p.m.

Machine threadups are illustrated in Figures 1, 2, and 3. Two smoothing rolls were positioned after the air knife in the coating system. The rolls were placed so that they just touched the web in its normal thread-up position. The first smoothing roll had a diameter of 2-13/16 inches and the second smoothing roll had a diameter of about 2-5/16 inches. These smoothing rolls were placed 10 inches apart. The supporting roll, a 2-3/16 inch diameter roll placed between the smoothing rolls and beneath the web at

Figure 1

Machine Threadup

Runs 10,820-1 through 10,820-11.

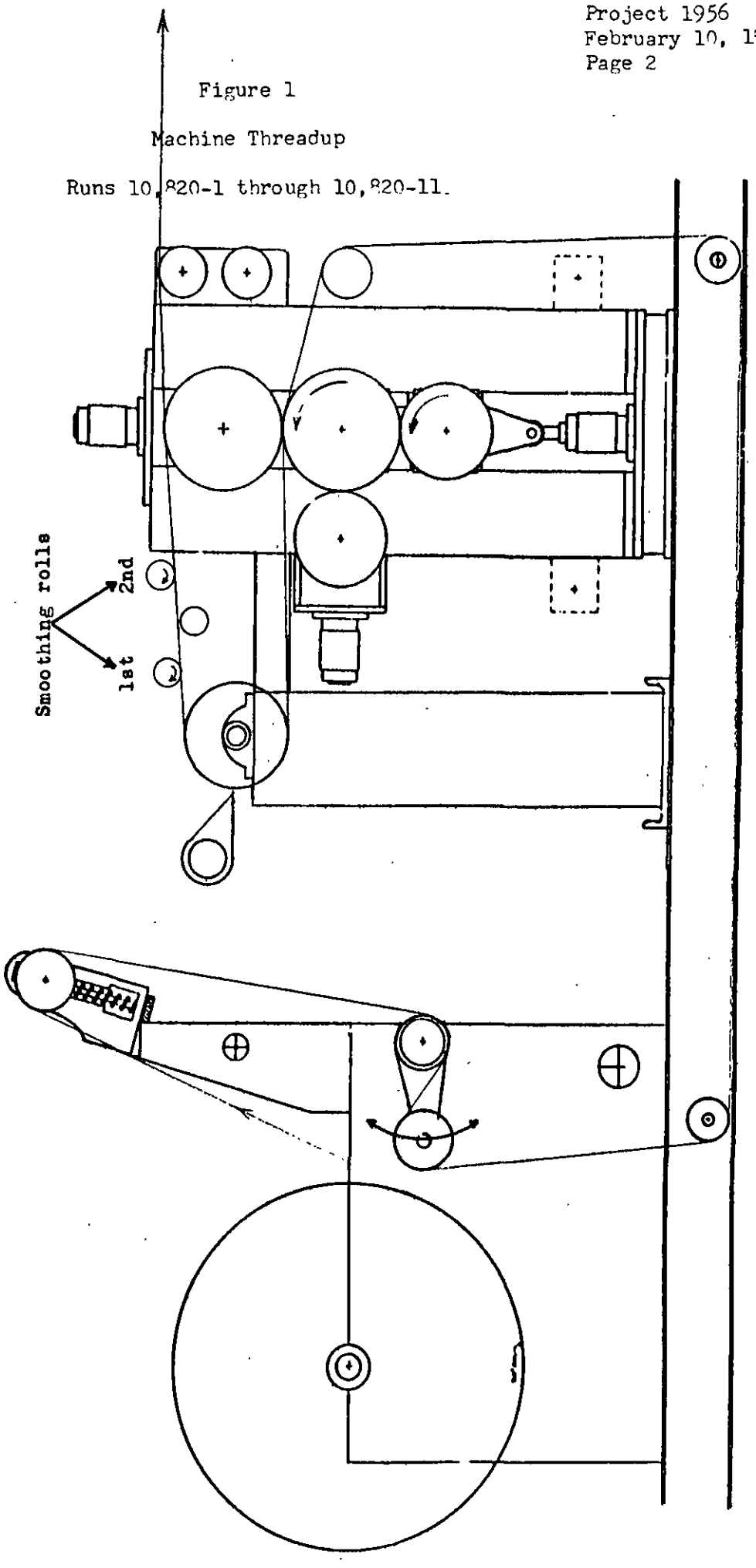

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Figure 2

Machine Threadup

Run 10,°20-12

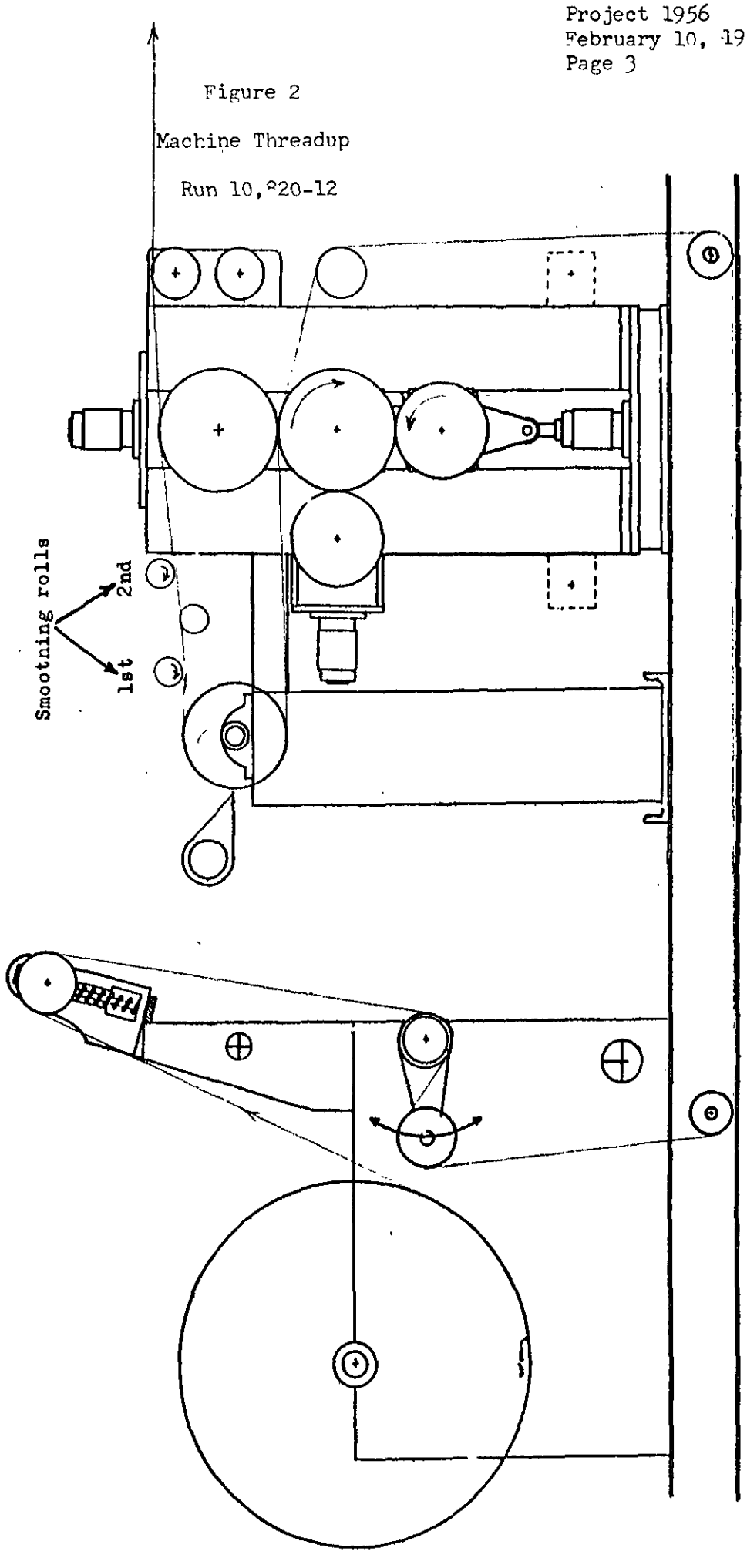

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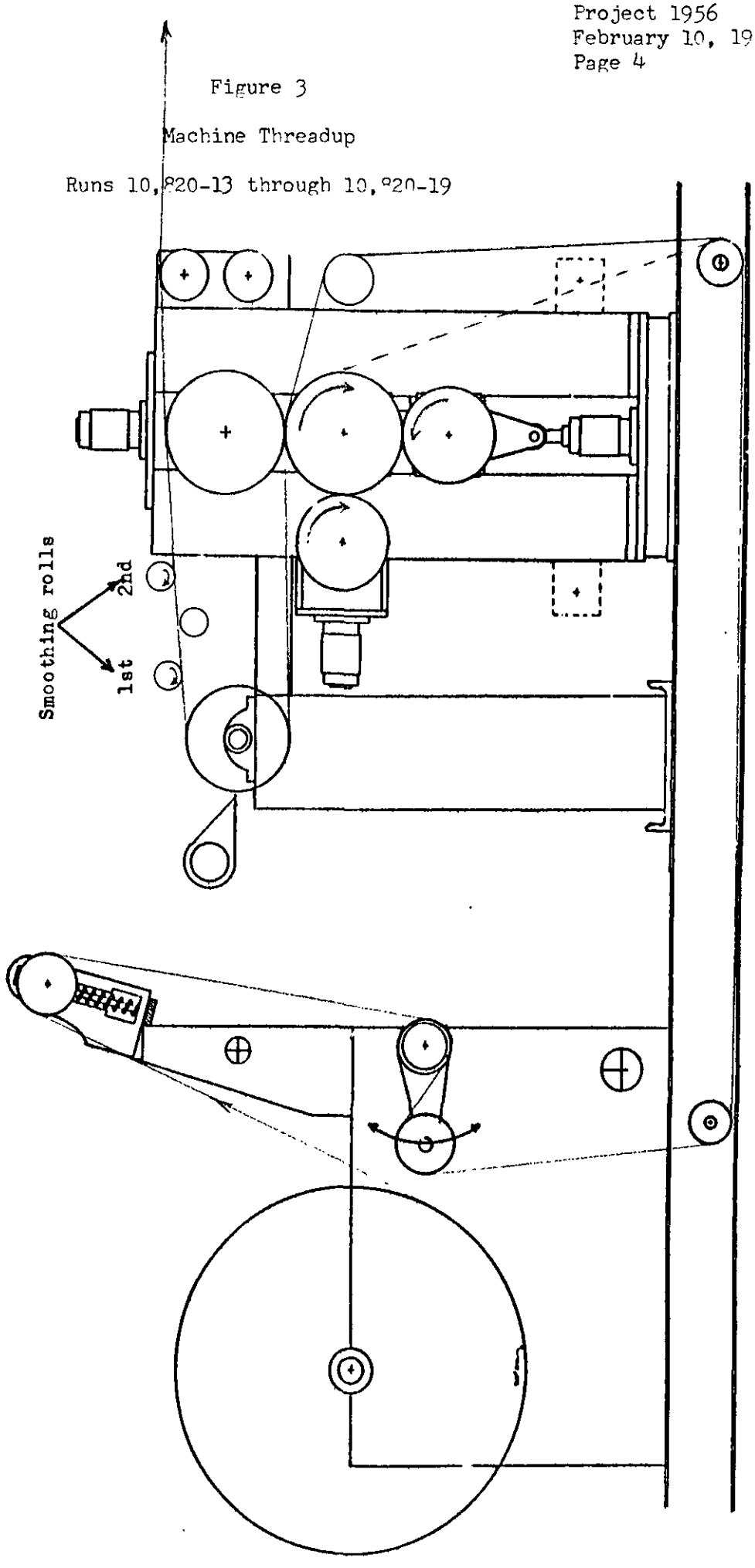
Figure 3

Machine Threadup

Runs 10,820-13 through 10,820-19



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a point about 6 inches from the first smoothing roll, can be adjusted to give the web varying degrees of wrap around the smoothing rolls. The amount of wrap will be recorded as the height of the supporting roll above the point at which the supporting roll just makes contact with the web in its normal threadup position.

The smoothing rolls were initially chain-driven by a 1/4 h.p., 1140 r.p.m. Type BC General Electric motor and controlled using a rheostat. As higher speeds were desired, the electric motor was replaced with a Gast Manufacturing Corp. Model 4AM air motor. The manner of operation duplicated previous work and the Contracoater and air knife settings are given in Tables I and II.

The coating was recirculated during the course of the coating trials. The color was pumped from a color pan overflow bucket by a 3/4-inch Jabsco pump driven by a 1/2 h.p. Dynamic Division Ajusto-Spede electric motor with a 5 to 1 gear reducer. The color was pumped into a 26-gallon capacity tank where it was under constant stirring using a Model DV1A Lightnin' mixer. The color was returned to the color pan from the bottom of the 26-gallon tank by a Model EFRC2 Viking pump directly coupled to a 1/3 h.p., 1725 r.p.m. Leland electric motor. In the high speed trials, the Viking pump would not furnish color at a fast enough rate and it was replaced with a Model EC15A Continental pump driven by a 1/2 h.p., 3 phase, Type K, G. E. electric motor.

The coating weights given in Tables I and II were determined by oven drying coated and uncoated samples in the oven for about 10 minutes and weighing in a hot balance.

TABLE I

AIR KNIFE COATING TRIALS

Run No.	Roll Speeds, ft./min.				Air Knife Settings				Coating Weight, lb./25X38-500
	Pan	Applicator	Rewind	Smoothing	Pressure, p.s.i.	Aperature, inch	Distance to breast roll, inch	Wrap	
10,820-1	180	101	500	Not used	1-1/2	.030	.100	Not used	2.8 (air knife side) 24. (reverse roll side)
10,820-2	180	101	500	578	3/4	.030	.100	1/8	4.4
10,820-3	180	101	500	578	5/8	.030	.100	1/8	4.5
10,820-4	180	101	500	760	5/8	.045	.085	1/8	4.5
10,820-5	180	101	500	760	1/2	.045	.150	1/8	5.2
10,820-6	180	101	500	760	1/2	.045	.150	3/8	8.0
10,820-7	180	101	600	835	7/8	.045	.150	3/8	6.0
10,820-8	180	101	800	835	1-1/4	.045	.150	3/8	4.2
10,820-9	180	101	1000	900	1-1/4	.045	.150	1/8	6.2
10,820-10	180	164	1000	770	1-1/2	.045	.150	3/8	5.9
10,820-11	180	164	1000	1320	1-3/4	.045	.150	3/8	6.0

NOTES:

Nip settings:
Pan roll to applicator roll nip, .012 inch
Meter and web roll to applicator roll, open

[1]One-half of the air knife aperature was taped shut.

TABLE II

CONTRACOATER COATING TRIALS

Run No.	Roll Speeds, ft./min.					Nip Settings, inch		Threadup	Coating Weight, lb./25X38-500
	Pan	Applicator	Meter	Rewind	Smoothing	Pan to Applicator	Meter to Applicator		
10,820-12	190	650		600	1350	.002		see Fig. 2	4.0
10,820-13	190	650	550	600	514	.010	.006	see Fig. 3	
10,820-14	94	914	485	800	514	.010	.006	see Fig. 3	
10,820-15	94	914	485	800	514	.006	.006	see Fig. 3	
10,820-16	94	914	485	800	514	.004	.004	see Fig. 3	
10,820-17[1]	94	1094	485	900	758	.004	.004	see Fig. 3[2]	
10,820-18[1]	94	1094	485	900	?	.004	.003	see Fig. 3[2]	
10,820-19[1]	94	1094	538	800	?	.004	.003	see Fig. 3[2]	

NOTES:

The smoothing roll wrap was 3/8 inch.

[1]The felt side of the base stock was coated.
[2]To obtain more web wrap around the applicator roll, the threadup was changed as shown by the dotted line in Figure 3.

RESULTS

The supporting roll for the web in the smoothing section of the coating system was finally maintained at a height of 3/8 inches above the horizontal level of the web in its normal threadup position. At times it was difficult to maintain a completely straight or even web and the effect of smoothing on a slightly uneven web was magnified at "wrap" conditions less than 3/8 inch.

Recirculation was not sufficient to prevent settling out of the NCR coating. A recirculation system other than an "overflow" type is needed. The overflow type recirculation was used because it is the easiest to control for maintenance of color level in the color pan. The color was stirred in the color pan by hand between runs to eliminate the effects of settling.

Samples of the coated paper are available in the Special Processes Section "Machine Trials" file.

The air motor drove the smoothing rolls faster than did the electric motor, but the control of speed of the air motor was more variable.

PROJECT REPORT FORM

PROJECT NO. 1956
COOPERATOR IPC
REPORT NO. 34
DATE March 29, 1960
NOTE BOOK
PAGE TO
SIGNED Frans Vaurio

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MAINTENANCE AND REPAIR OF CONTRACOATER

This report describing work done in September, 1956, is being written to help establish an historical record of the steps taken to improve the operation of the Black-Clawson Dilts Laboratory Contracoater.

Our preliminary trials with the machine indicated serious misalignment immediately after the initial setup. This was rectified by Bob Rae and Milo Godschalx of the Engineering Department who realigned the unwind, coater and rewind units. A transit was used to check alignment.

A check of the runout of the coating rolls by actually coating paper and by checking with a dial indicator showed that the behavior of the coater was unsatisfactory. Skips in coating were observed. The machine had been reconditioned by the Dilts Machine Division of Black-Clawson Company to bring it into "first class condition" (see their letter) shortly after it had been purchased. They installed new bearings and had the rubber roll ground. When they were informed of the unsatisfactory behavior of the machine, they claimed they were not equipped to check the runout of the rolls.

Wes Marx, head of our machine shop, was authorized to help check the runout of the rolls while the rolls were in the machine. This is covered in Project 1625 Report Number 2, and the indications were that considerable improvement was desirable since the runout on the metering roll was 0.0010 inch maximum, and on the applicator roll 0.0020 inch maximum. Since these two rolls are the ones

that do the metering of a reverse roll application, it was felt that a variation of coating as high as 0.0030 inch might result. The rolls were removed and checked in their bearings and clamped to the milling machine table by Mr. Rae and Mr. Godshalx. A runout as much as 0.0012" was noted.

Since it became evident that we could get no help or adjustment from Black-Clawson Company, it was decided to have the rolls ground locally. Mr. Rae contacted the Hewitt Machine Co. of Neenah for this work. (See our purchase order G-5051). The rolls were ordered ground to 0.00005 inch runout. Unfortunately, when our driver, who was not versed in the proper handling of highly finished rolls, picked them up from the machine shop and set them in their paper wrapper on the concrete floor, the rolls were marred by dirt particles pressing through the paper under the weight of the heavy roll. Hereafter, all rolls should be handled in wood boxes with the roll supported by the shafts at each end.

The rolls were next checked for runout while they were mounted in their bearing blocks which were clamped to the milling machine table. A runout of approximately 0.0008 inch was obtained for both the metering and applicator rolls. This would mean a possible 0.0016 inch variation in nip opening which would be undesirably large. Also, it was noticed by Mr. Feavel that one of the bearing housing lugs had been broken off and welded since he had last handled the rolls.

The Hewitt Machine Company was called in Bob Rae's absence to learn the possible reason for this apparently poor machining job. It was learned that the rolls had not been ground while in their bearings, but that the bearings had been removed and the rolls ground while on centers. Mr. Heise of the Hewitt Machine Co. was surprised to learn the extent of the runout. He admitted they had broken the bearing housing accidentally, and explained that they were unable

to grind the rolls while in their bearings or their lathes because the rolls were too short. He felt a special tool would be needed to handle the short rolls and apparently it would be more costly if they were to be required to grind the rolls while mounted in their bearings.

The cause of the excessive runout was therefore attributed to either the bearings or to the lack of concentricity between the roll surfaces and journal surfaces. However, when the bearings were removed it was discovered that the journals were in poor shape (badly scarred) and that there was considerable clearance (as high as 0.005 inch) between the journals and bearings.

The metering roll and applicator rolls are equipped with adjustable double row Timken cone bearings, while the other rolls have self-aligning bearings. The self-aligning bearings are equipped with Collet type inner race to assure snug fit on shaft.

Lyle Dambruch found that new cones with a smaller inside diameter could be purchased and the journals were machined to fit. A light cut was made on the hubs in order to have a good surface where the rolls were supported by the centers. Wes Marx machined the journals on the metering roll and achieved an excellent fit with 0.0002 inch maximum runout while the roll was held in the lathe centers. (The original Timken #387 with 2.2500" bore bearing cones were replaced with new Timken #389 2.1880" bore bearing cones). The recommended practice of machining the journals to give a shrink fit of the bearings which are preheated in oil at 250°F. did not appear practical since the bearings had to be assembled in parts and adjusted to the proper tightness.

The applicator roll diameter proved to be too great to be handled in our shop so it was returned to Hewitt Machine Co. as suggested by Lyle Dambruch. (See our purchase order G-5717).

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WIRE WOUND ROD COATING

This report is a description of the setup used by Kimberly-Clark Corporation to coat a Dacron (polyester fiber) non-woven sheet with a clay-polymer latex mixture using a wire-wound rod to meter the coating. This work was done under Special Number 11,214 but is being written as an Institute Project for the purpose of accumulating information useful to the operation of the Institute Experimental Coater. This information is to be considered confidential.

The Institute Experimental Coater has not been used to apply coatings by this technique. However, when Mr. Leroy Goldbeck first came to the Institute to appraise our coating facilities it was believed that the air knife technique might be satisfactory. In discussing this with his fellow research workers some felt that the air knife method would be unsatisfactory. Mr. Goldbeck had found the trailing blade technique unsatisfactory as the coating weight that could be applied was found to be too low. Their best results were with wire wound rods. They had not tried the reverse roll coating technique. Their Black-Clawson Dilts Reverse Roll Coater is still not in operation since the recent explosion they had suffered. Their plans are to put up a special building with suitable explosion-proof features at some remote spot. However, their plans are not being pushed to get this done very soon. Mr. Goldbeck attributed the explosion to the failure of a safety device--an explosive limit indicator--which had been poisoned by silicone resin which was being applied from a methyl ethyl ketone solution.

The wire wound rod holder which had been used on the old Waldron laminator

was examined and it was decided that the Kimberly-Clark Laboratory would build new brass slotted rod holder parts and use this as a metering device on the Institute Experimental Coater to do the coating operation.

On March 22, 1960, Mr. Leroy Goldbeck and one of the Kimberly-Clark laboratory helpers came to the Institute for the coating trials. Don Fird operated the coater. The area was closed to all visitors at the request of Mr. Goldbeck. They brought three small rolls, about 200 feet of material on each roll, of Dacron fiber paper or non-woven fabric and two 5 gallon cans of coating material. The rod holder and rod (tight wound with about a 34 or 38 thousandths inch diameter wire) were mounted just above the lip of the coating color pan on the unwind side of the machine. (See Figure 1.). The web was threaded as shown in the Figure 1. An excess of the coating was applied to the web and metered with the wire-wound rod.

The pan was filled by pouring the coating through cheesecloth stretched over the mouth of a stainless steel funnel which was fitted with a hose that led into the color pan.

The speed of the D. C. motor was adjusted to 457 r.p.m. which gave a web speed of 20 feet per minute.

The infrared heaters were set at 300°F. This temperature was found to be too low to dry the coating at 20 feet per minute. When the heaters were set at 400°F. the coating dried unevenly. The speed was reduced to about 10 plus feet per minute and the heaters held at 300°F. for subsequent trials.

At the low speed operation it was observed that there was a jerky action at the unwind stand. This had been observed in our use of the coater previously and always seemed to occur when the diameter of the roll on the unwind shaft became small

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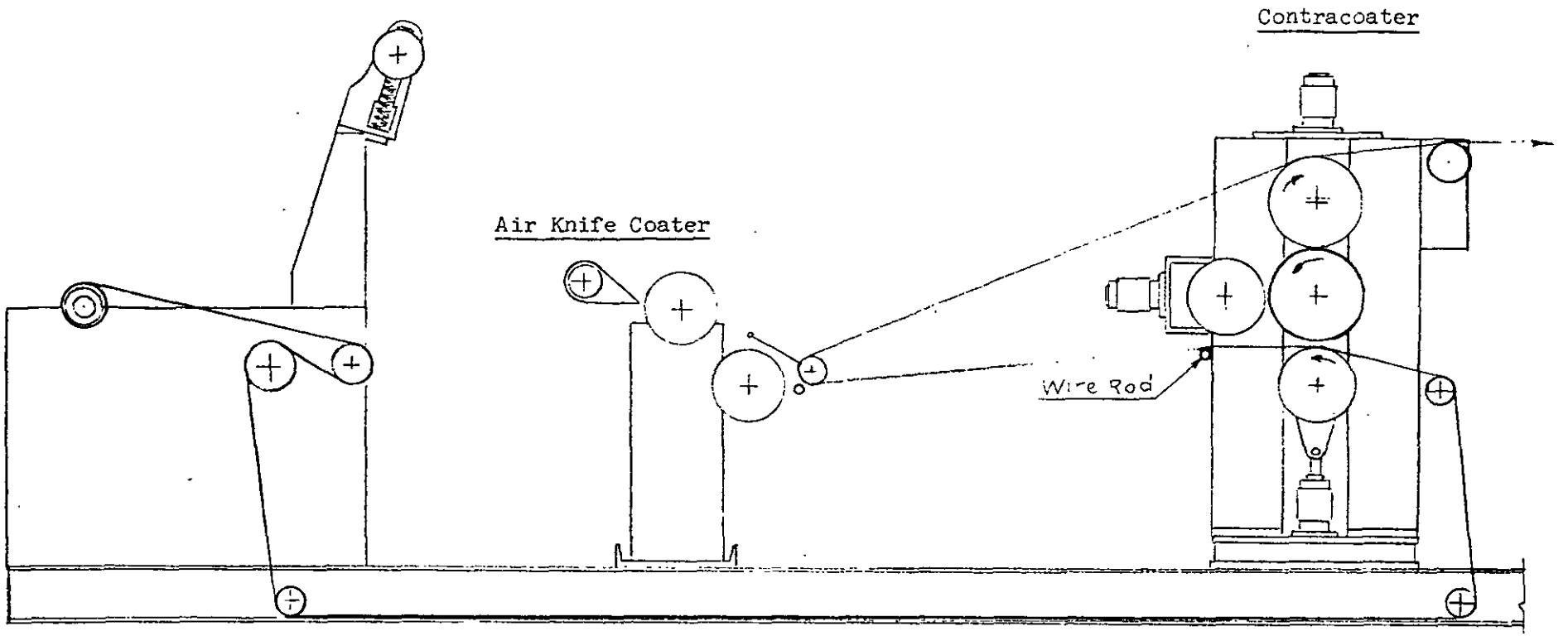
Design Sheet : 1



(perhaps with 500 or so feet of paper). The Dacron was rewound or a 10-inch diameter roll of paper which had been left over from previous runs on the machine. This smoothed out the jerky action but the coating still could not be applied satisfactorily. The major difficulty was due to the web being baggy in the center and the edges tight. The other difficulty being the tendency of the coating to permeate through the sheet and accumulate on the various carrying rolls. The bagginess was apparently due to uneven temperature on the new Kimberly-Clark laboratory calendar which was used for the first time on the material for this run. The center of the calendar rolls was hotter than the edges and allowed the thermoplastic fiber to flow more at the middle of the web according to Mr. Goldbeck's assistant.

The Dacron web, according to Mr. Goldbeck, does not stand much tension in the drier section. In order to minimize the tension on the web some of the carrying rolls and the tension control roll were by-passed as shown in Figures 2 and 3. The operation of the unwind brake and tension control on the Institute Experimental Coater is not very satisfactory. For light weight webs the action is too coarse and for heavy weight board the action tends to become erratic due to the +V-block brake action. The wood blocks tend to cause jerky action. The possible use of a leather strap and weight was mentioned as a means of handling light weight web tensions. The unwind shaft is not straight and one of the idler rolls is very badly out of balance. These are to be corrected and work orders have been prepared.

Mr. Goldbeck estimated the value of the Dacron sheet at $5.00 per lb. Attempts to use a paper leader to conserve on material were unsuccessful because the joint pulled apart. One roll was coded SF 54.

Mr. Goldbeck declared the web unsatisfactory. He was not sure if they would be back for further trials.

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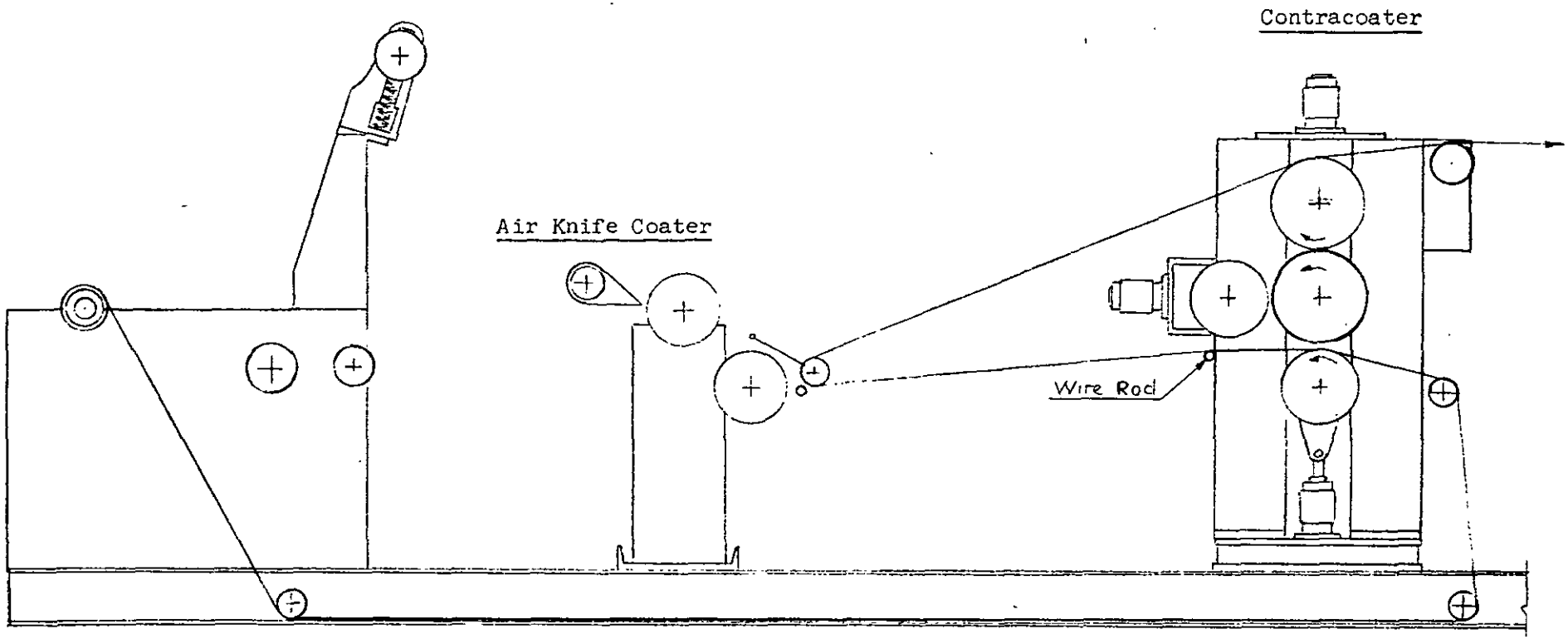
Design Sheet: 2



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Design Sheet: 3