4-1984

Design, Construction and Operation of a Four Stage Sidehill Screen Deinking System

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DESIGN, CONSTRUCTION AND OPERATION

OF A FOUR STAGE

SIDEHILL SCREEN DEINKING SYSTEM

BY
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A Thesis submitted

in partial fulfillment of

the course requirements for

The Bachelor of Science Degree

Western Michigan University

Kalamazoo, Michigan

April, 1984

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Keywords : Deinking; Sidehill Washers.

OBJECTIVE

The objective of this thesis project was to design, construct and place into operation a four stage sidehill screen deinking system.

REQUIREMENTS

The requirements of this system were:

1) Four separate stages.

2) Continuous operation.

3) Small pilot size production rate.

4) Portable-- small enough to pass through door-ways.

5) Easy usage.

6) Easy cleaning.

7) Easy to change flows-- both stock and wash water.

8) Multiple screen meshes-- easy to clean.

9) Valves-- flow adjustment.

DESIGN

The first step in the design of the system was to see how industrial systems were built. The research was to determine the basic design of the system, and match as closely as possible with industrial sized equipment.

The production rate of this system was set at approximately twenty pounds per hour. This was a median value with valves to increase or decrease this production rate. It was found that industrial sidehill screen systems had a production rate of approximately five tons per day per foot screen width. With this rule of thumb, the screen width for twenty pounds

per hour would be less than ½". Therefore a screen width of four inches was chosen to make the system practical for small scale pilot usage. It was found that the typical angle of most industrial systems was 38 with a range of values running from a low of 25 degrees to a high of 60 degrees. The length of the system was chosen to be five feet. This corresponds to the average industrial length of twelve feet. The first design that was made was designed with each stage having a fixed screen that could not be easily removed or changed. After consideration of this, it was decided that in order to make the system versatile, the screens should be made so they could be removed easily. Frames were designed that could be placed into each stage easily and that each stage would have a set of screens with different meshes. The screens that are available for this system are 60, 80 and 100. This allows for quick and easy changing for the different stocks that can be run on this system without any lost time.

The next step was to define the typical flow for this system. Figure 1 shows the system under a full counter-current wash water flow.

The first drawings were then made to get an idea of what the system would look like. This drawing is shown

in figure 2. From this drawing a number of changes were made before the next draft was made. The water deflecters were changed from perpendicular to the screen to perpendicular to the base of the system. The width of the screen was reduced from four inches to three inches. Also the screen sections were to be placed into frames, rather than fixed to each stage, for ease in changing screen meshes during operation.

At this point the first final drawing was produced with all the stages on one platform. Figure 3 shows this system completed. Figure 4 shows a parts diagram for all the wood parts that was needed for construction. The tanks were to be placed on the floor and each tank had a total capacity of ten gallons.

After the completion of these two drawings, a prototype of one stage was built to see what one stage would look like and to also determine what problems might arise during construction. After the prototype was accepted, the materials required for the construction of the system were ordered. All wood used for this system was Red Tidewater Cypress. All screws used for fasteners on all the wood parts were brass wood screws. All piping used on this system consisted of 3/4 inch garden hose with quick connections on all the pumps. The tanks and pumps that were

obtained called for the first major design change during construcion. The pumps mounted directly to the drain of the tubs that were used for tanks. The bottom of the tanks sit approximately two feet from the base of the system, and were larger in length and width than what was shown in the final drawings (see figure 3). The capacity of these tubs is slightly greater than 18 gallons. This change caused the stages to be arranged differently on the platforms. The one platform was split down the middle creating two platforms of two feet in width each. The two stages on each platform were than placed back to back rather than side by side. Figure 5 shows the final drawing with all the design changes. Figure 6 shows the front view of one stage. Figures 7 and 9 show side views of the entire system. Figure 8 shows the front view of the entire system.

After the system was completed, trials were run to determine what problems would arise during the operation of the system. The only major problem that arose during operation was stock build up on the screens. The stock dewatered too quickly and stacked up on the screens and stopped rolling down the screens as expected. This caused the stock coming from the headbox to flow over the top of the plugged stock and run down the side wood strips into

the tanks, rather than down the screens. To elminate this problem the angle of the system was changed. The angle of the screens was increased from 38 degrees to 50 degrees. This angle of 50 degrees is still within industrial limits of 25 degrees to 60 degrees. After this was done, the stock rolled down the screens without major plugging of the stock on the screens as before.

OPERATION

After trials were made on the runnability of the system, a trial was made to determine the usability of the system. Figure 10 shows samples of this trial. The paper used was a high quality printing grade with high ink coverage. It was pulped up at 180 degrees for twenty-five minutes at four percent consistency with 2.5 percent NaOH added based on O.D. fiber weight. After pulping, the stock was diluted down to 0.5 percent consistency and was then ready to be washed on the deinking system. The results of this trial are shown in figure 11. The brightness increase was slightly greater than 14 percentage points. This increase corresponds to a normal increase of about 10 percentage points. The consistency increase of 0.52 percent to 1.9 percent is less than the average industrial system.

Industrial systems usually get a final consistency of four to eight percent. The difference is mostly due to the small screen width in this pilot system that does cause some channeling of the stock, and thus a little less dewatering.

These results show that this system can be used to simulate industrial type systems. It can also be used to study different aspects of wash water flows on the final pulp quality.

USE

This system was designed for easy use and can be used with little effort. Flows from all pumps are adjustable to nearly any flow rates. The only consideration, should be to allow enough running time to allow enough wash water to build up before the full effect of countercurrent washing can be realized. Before enough water is obtained for this, fresh water is needed to dilute the stock down to approximately 0.5 percent consistency before each stage of washing.

ACKNOWLEDGEMENTS

Campbell, Rich-- Aid in welding headboxes

Caldwell Tanks, Inc.-- Red Tidewater Cypress

Koster, Cris-- Aid in construction

KTS Industries-- Design problems and wood

Plainwell High School-- Use of metal shop

Plainwell Paper Co.-- Materials and labor for headboxes and water slide

Ronningen-Petter Co.-- Screens

FIGURE 1

COUNTERCURRENT FLOW DIAGRAM

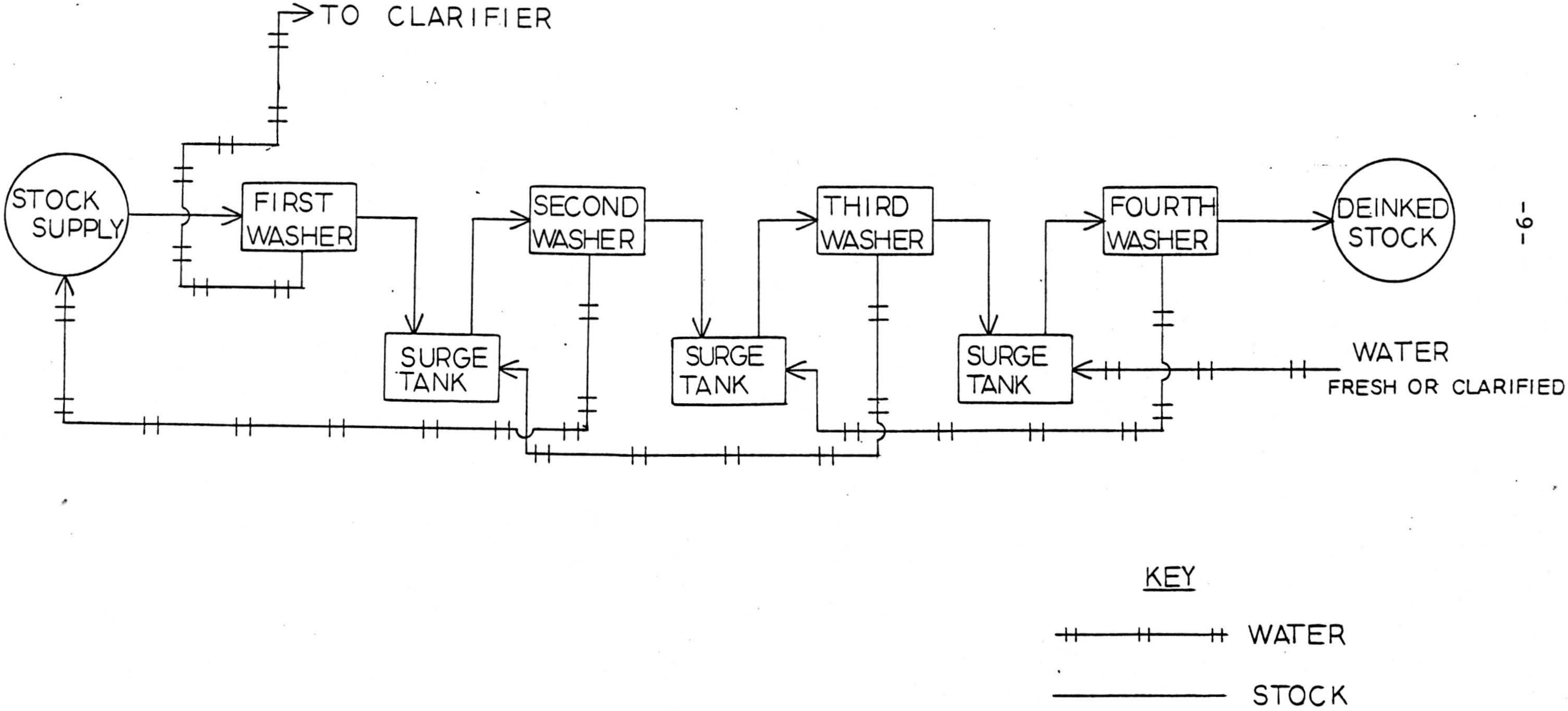


FIGURE 2

BASIC SYSTEM

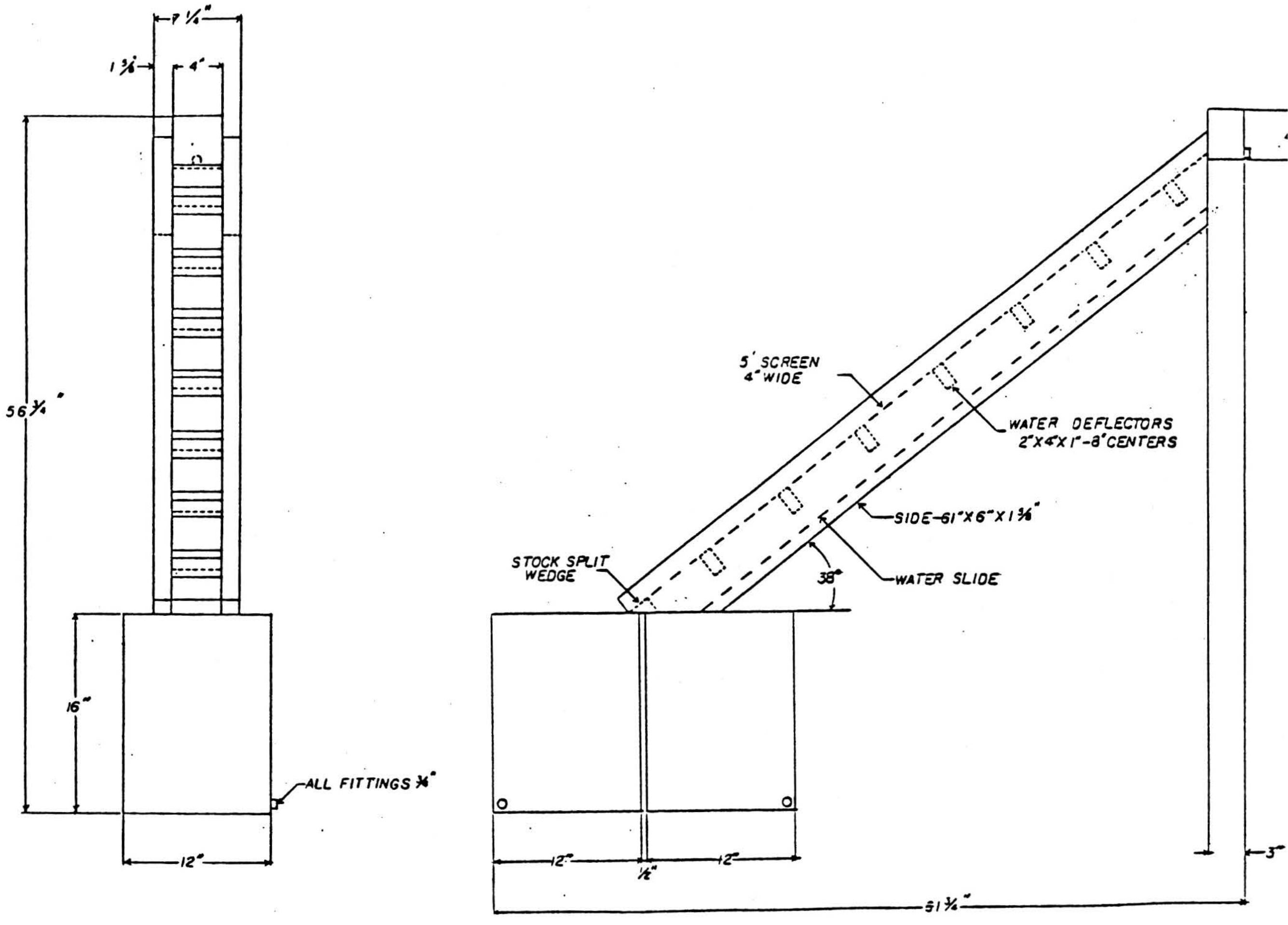
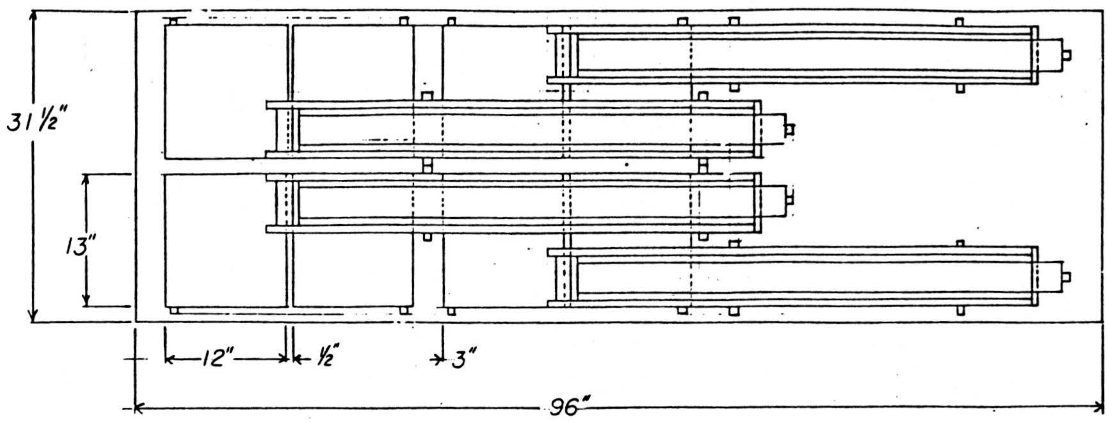


FIGURE 3

FIRST FINAL DRAFT OF TOTAL SYSTEM



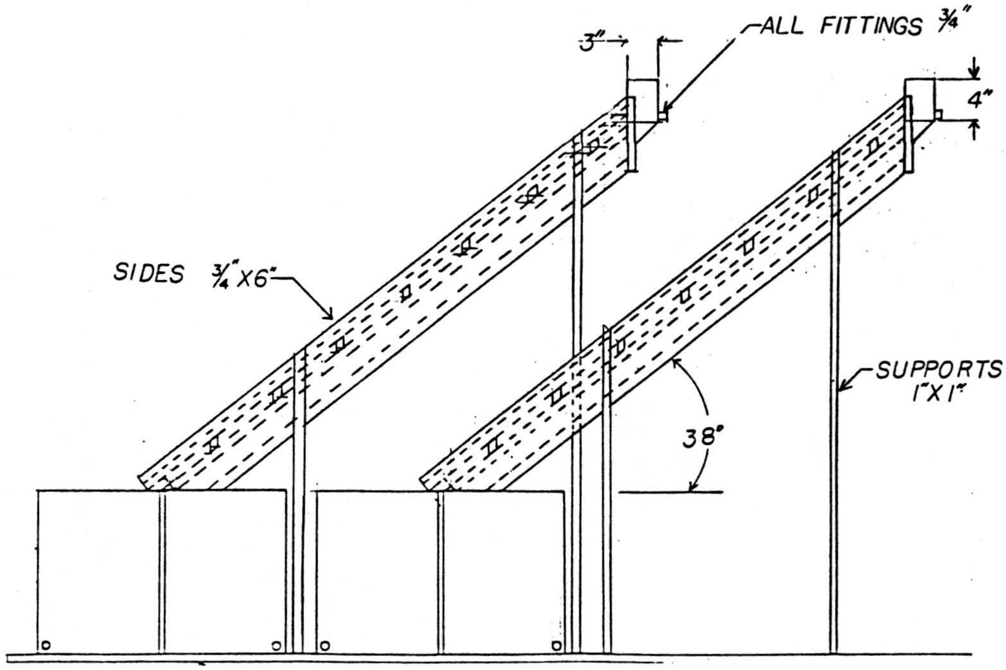


FIGURE 4

WOOD PARTS DIAGRAM

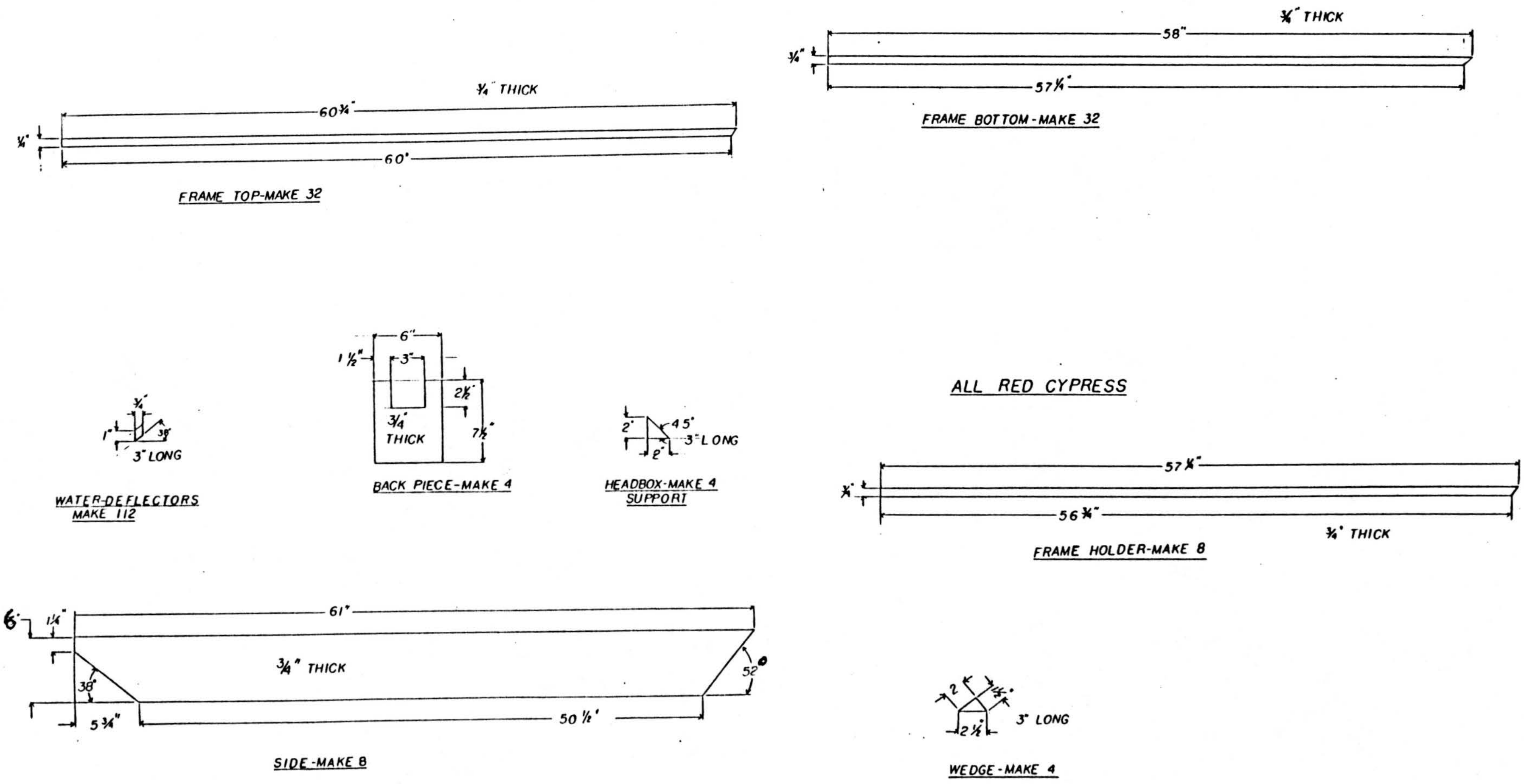


FIGURE 5

FINAL DRAFT OF TOTAL SYSTEM

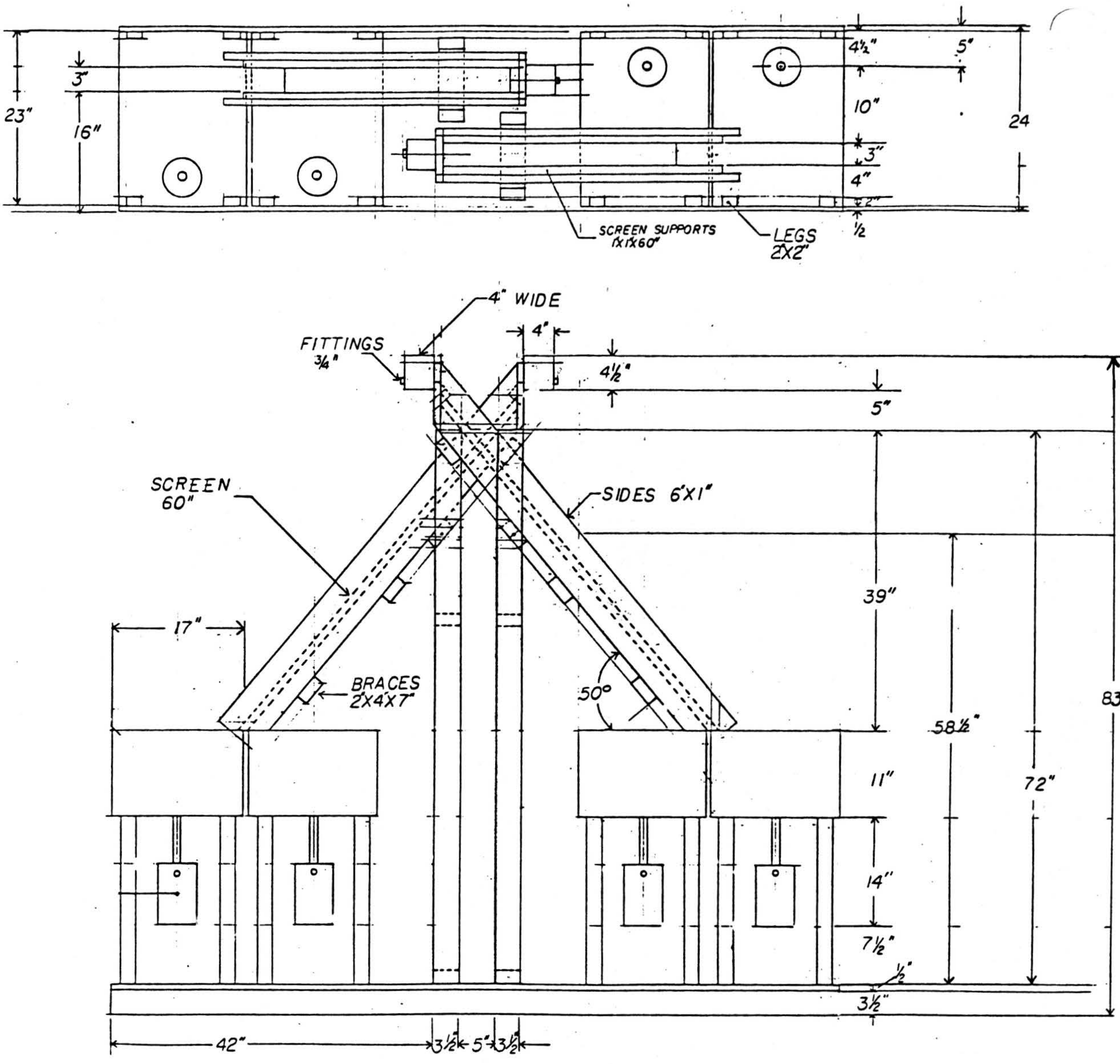


FIGURE 6

FRONT VIEW OF ONE STAGE

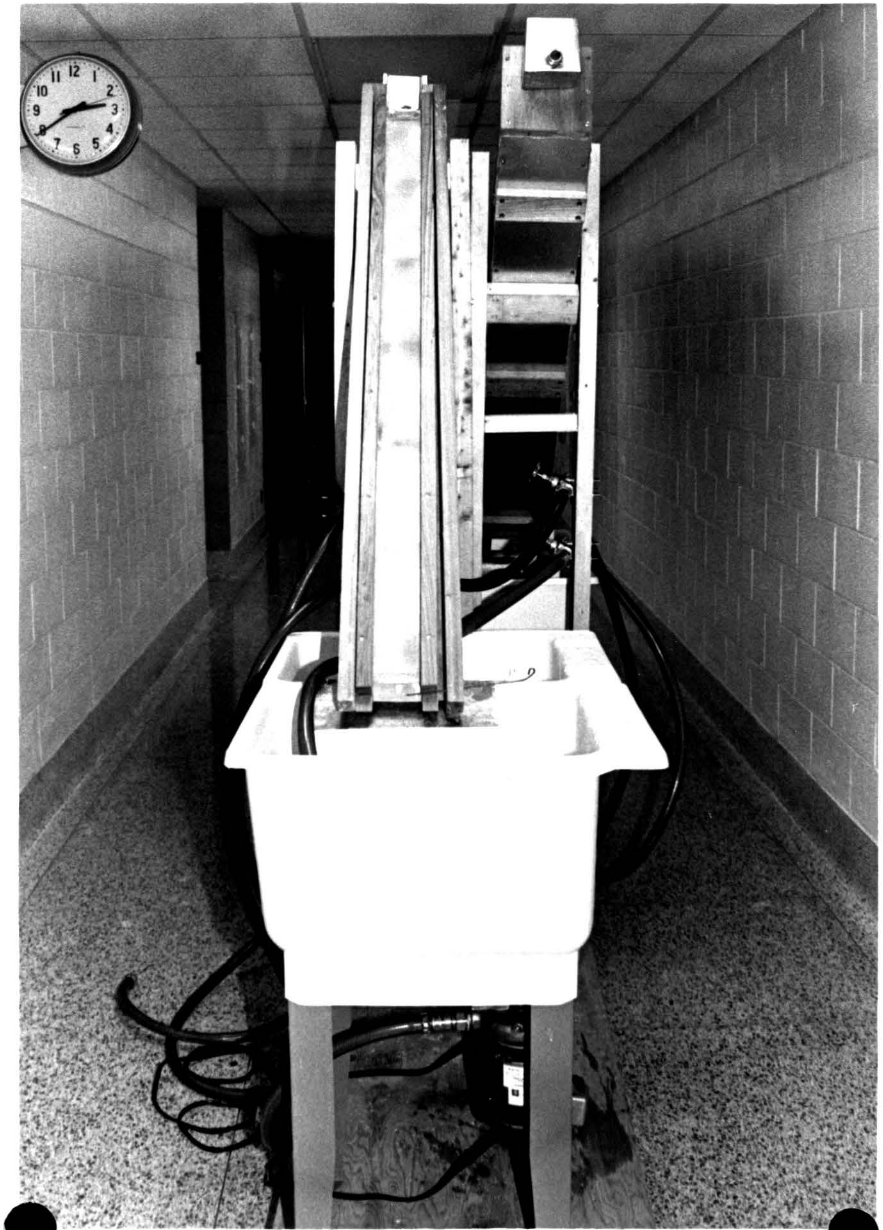


FIGURE 7

SIDE VIEW OF ENTIRE SYSTEM

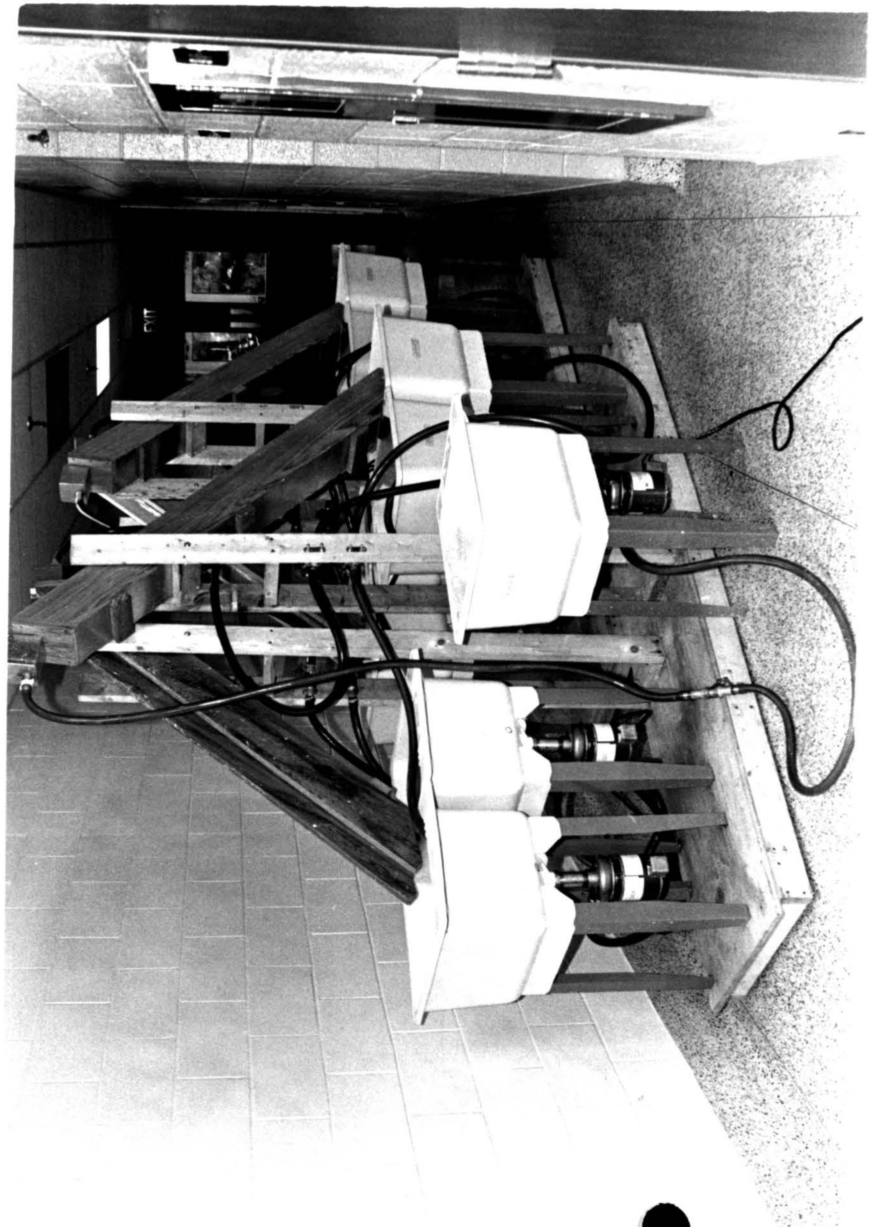


FIGURE 8

FRONT VIEW OF ENTIRE SYSTEM

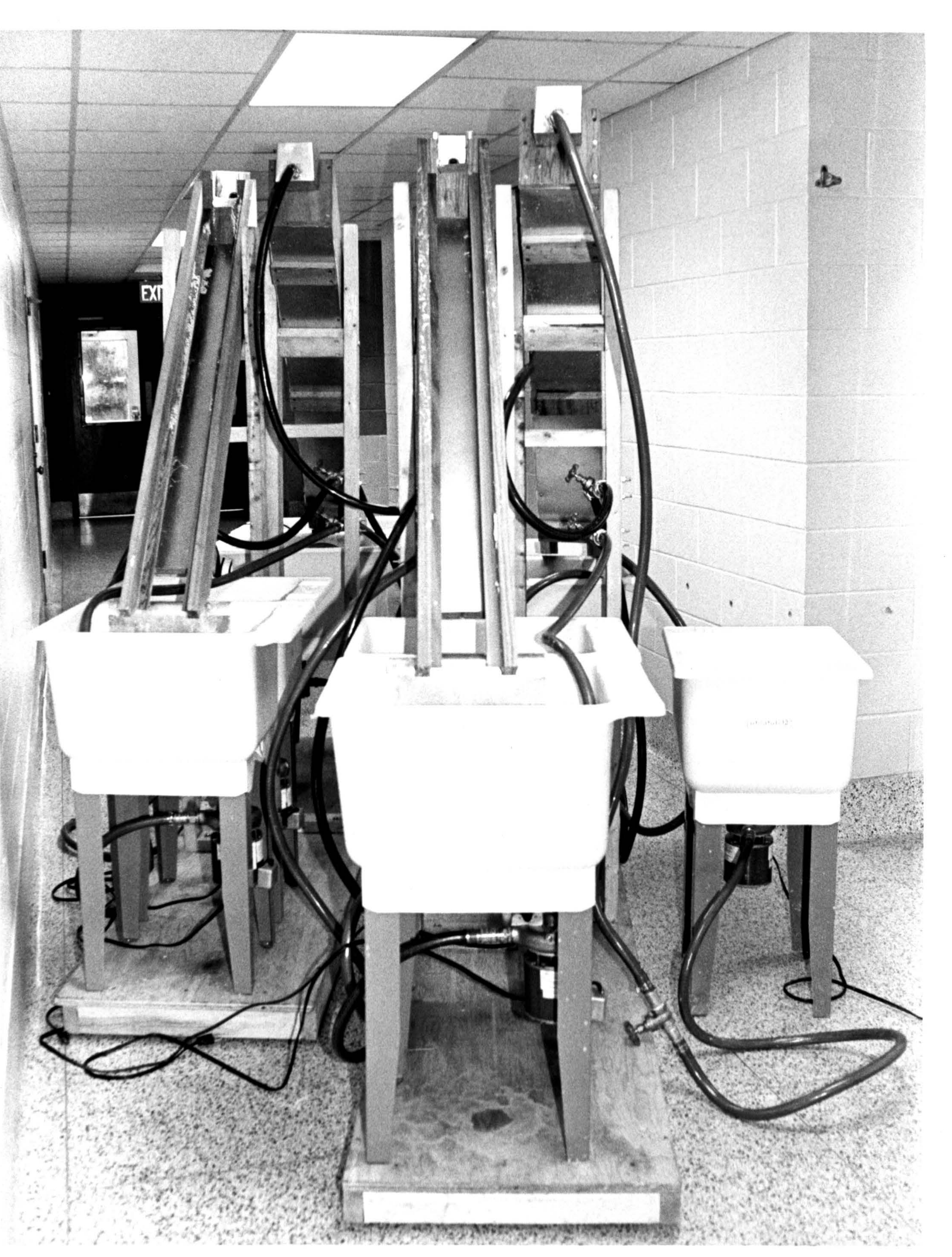


FIGURE 9

SIDE VIEW OF ENTIRE SYSTEM

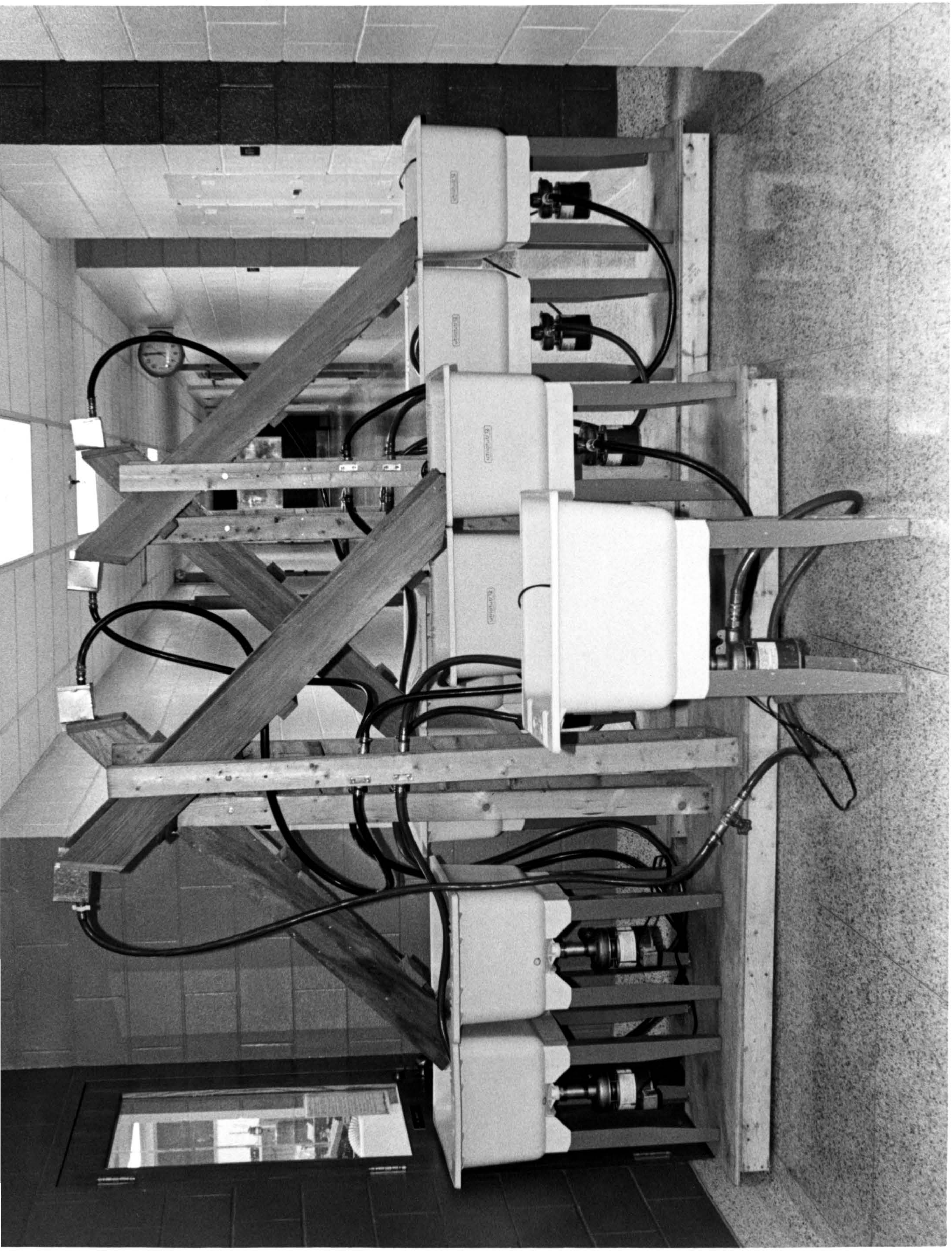
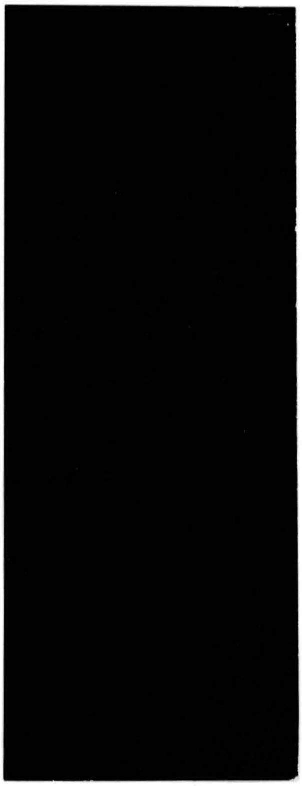


FIGURE 10

TRIAL SAMPLES



STOCK BEFORE PULP ING

BEFORE SCREENING

AFTER SCREENING

FIGURE 11

RESULTS OF TRIAL RUN

	BRIGHTNESS	CONSISTENCY
INITIAL	62.9%	0.52%
FINAL	77.2%	1.9%

PRODUCTION RATE

5 gallons per minute at 0.52% consistency = 13#/hour