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Subject Pipe Machine Information		From F. [Signature]	Location and mailing BB 2126

PLAINTIFF'S EXHIBIT

CT-1474

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Please find enclosed the translation of an article concerning the set-up of a pipe machine equipped with a top felt and including two cylinder molds.

This machine is very specialized because it only produces pipes from 8" to 20" and its high productivity is not evident; however, certain technological characteristics are interesting and show if necessary the merits of a roll conveyor in the curing tunnel where a high hygrometry exists (95-100%).

It is a fact if the electrical equipment allows and if the vacuum possibilities are sufficient that the product is of better quality with a thin than with a thick web in equal production.

If you have comments or suggestions, please let me know.

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STARTING UP OF ASBESTOS CEMENT PIPE
PRODUCTION ON THE "VOITH" LINE

The asbestos pipe manufacturing companies have adopted an installation manufactured by the Austrian firm "Voith". This installation will replace the obsolete model SM-871 pipe-making machines in connection with the reconstruction of the existing plants and the construction of new ones. It is characterized by high productivity, and has design and technological characteristics whose analysis is of particular interest for the experts of this branch of industry and of machine building in general.

The "Voith" line begins with a scoop type mixer of cylindrical shape, having a diameter of 6.9 ft. and a length of 8.2 ft. It mixes 177 cu. ft. of batch at a time. The batch level is controlled automatically, and the discharge is regulated by a flap (gate) that is opened automatically or is controlled by an operator from the control desk, ensuring the necessary working concentration of the batch in the homogenizer and the corresponding thickness of the asbestos-cement layer on the felt.

The batch is charged into the vat through two pipes with rubber inserts. Their cross-section and the feed rate of the batch can be regulated by means of a reducing device. In contrast to the known models, the size of the vat is increased so much that two cylinders with a diameters of 39.4" using "stocking" screens, and four paddle agitators are placed into it. The agitator speed can be regulated between 55 and 220 rpm by means of speed variators installed on each hydraulic drive. If necessary, the operator can also reverse the direction of rotation.

In the vat, the slurry is first treated with an oscillator (vibrator), the oscillation of the rib of which facilitates the homogeneous distribution of the batch over the surface of the cylinder. The seamless screen on the cylinders is intensely washed with water under a pressure of up to 140 psi from sprinkler pipes. In case of accumulation of the batch in the peripheral part of the vat, the machine operator can additionally add water in that place. The float system controls the batch level in the vat and reliably prevents the vat from overfilling. An automatic system can be turned on from the control panel to wash off the asbestos-cement layer (cylinder slug) formed on the cylinder molds during short-term stoppages of the machine.

The two-layered asbestos-cement web is dewatered on the felt by two vacuum chambers, and the web usually has a thickness of .009-.01 inches in the pipe walls. The covers of the vacuum chambers are made of anti-friction plastics. The diagonal slots on the covers facilitate the movement of the felt and prevent it from shifting. On their edges, the chambers are equipped with additional attachments which reduce the moisture content of the ends of the pipe being formed. In upside-down position, a third chamber is mounted in the lower section of the felt between the cylinders. The vacuum installations generate a vacuum of up to 15.8 inches Hg in the three suction boxes. The other suction boxes are connected to the fans; they dewater the upper and lower felts after cleaning and washing.

The felts on both sides of the machine are tensioned by hydraulic cylinders, whose rods are connected to the tensioning rollers.

The pressure change in the hydraulic cylinders ensures the uniform tensioning of the felt. Misalignment is eliminated by the switching on of the drives, which shift one of the ends of the tensioning shaft.

The pressing assembly, with a weight of about seven tons, is equipped with two press cylinders with a diameter of 7.5 inches; additional pressure is transmitted to them by five roller groups from the hydraulic cylinders attached to the press beam. The pipe molding cycle is determined on a diagram; its parameters are set by the machine operator from the control desk: they include the initial pressure, the wall thickness of the pipe above which this pressure starts to drop, the pipe thickness beyond which the pressure is maintained unchanged, and the value of this residual pressure. When the pipe thickness reaches the necessary value, the machine stops and the pipe is transferred on the mandrel to the calender, which is equipped with an automatic device which stabs the two ends of the pipe for opening. The drive of the lower rollers of the calender has a hydraulic motor with continuous speed regulation; the spacing between the rollers is variable. The duration of the stabbing with compressed air supply into the gap between the mandrel and the pipe, as well as the duration of the calendering, are set by the machine operator from the control panel.

A new system has been adopted in the machine for extracting mandrels and placing them on the support shaft. The special devices extract the mandrel to the side, after which they move it to behind the pressing assembly.

The mechanism of this system is set into motion by five hydraulic motors. The mandrel change time is improved, but the number of mandrels has increased: four mandrels with a diameter of 8" or three with a diameter greater than 8 inches circulate simultaneously.

A favorable feature of the machine is the use of cardan gears. This facilitates the assembly and improves the reliability of operation. The main drive of the lower felt of the machine has a d.c. electric motor ($N = 70 \text{ kW}$; $n = 1,800 \text{ rpm}$). Via a V-belt drive, it is connected with a reduction gear; the rotation is transmitted to the anvil roll having a diameter of 25.6 inches by means of a heavy-duty cardan shaft. The upper felt is provided with independent drive ($N = 22 \text{ kW}$; $n = 1,600 \text{ rpm}$).

Any felt speed between 50 and 200 feet/min., can be set from the control panel along with the necessary lead (by 4.5%) of the upper felt. The variable speed drive makes it possible for the machine operator to avoid occasional rejects by using low speeds; if the raw material is of good quality and the production is running smoothly, it is possible to form pipes at increased speed, which is a major advantage of the machine.

The hydraulic system of the pipe-making machine is equipped with a modern apparatus; the oil is delivered by a pump with a capacity of 0.36 gals/sec. under a pressure of 1140 psi. About 90 different distributors, valves, and other devices are involved in the automatic control of the pipe-forming process. The machine is equipped with a separate pneumatic unit, into which compressed air under a pressure of 85 psi is delivered by a compressor with a capacity of 24 cfm.

At the Zhigulevsk Concern for Building Materials, as well as at the Kiev and Alekseevka Concerns of Asbestos Cement Products, "Voith" conveyors with a length of 197 feet were installed for curing the pipes. They are placed in a flat tunnel, at the end of which an air heater with a capacity of 1,600,000 BTU/hour with a 1410 cfm blower is installed. The humidified air is distributed from a duct over the entire length of the tunnel in counterflow to the direction of the movement of the pipes. The temperature in the tunnel is maintained at 120-140°F and the humidity at 95-100% by an automatic system; these parameters are recorded by automatic recording instruments. The construction of the roller bed has the following features. The spacing (pitch) of the plate chains is 6 inches. Through one link a bushing is welded into the plates for the roller journal; the inner surface of the bushing is made of a material that does not require lubrication. Thus, the rollers with a diameter of 7.64 inches are spaced at 12 inches and the gripping angle for pipes with diameters of 8", 12", 16", and 20" equals 95°, 69°, 60°, and 50° respectively, i.e., it varies over a wide range. The surface of the rollers is coated with a special lacquer. On the upper section of the conveyor, they roll on three supports each, and on the lower section, two on each.

The conveyor speed and the speed of rotation of the pipes can be varied continuously from 26 to 160 feet/hr. according to the operation of the conveyor and of the pipe-making machine. Pipes with diameters of 8"-10" are on the conveyor for 4-5 hours, pipes with diameters of 16"-20" for 10-17 hours.

Due to the intensive heat treatment at high humidity, the pipes have sufficient time to reach the necessary strength before being transferred into a basin containing water at a temperature of 68-77° F for 8-9 days. The long-term water hardening makes it possible for the pipes to reach high strength, but it requires the installation of 30 basins for each line. Therefore, after the reconstruction of the plant, these basins occupied part of the place of the former hot storeroom. This requires, in turn, the smooth supply of freight-cars for shipping the finished products.

At the Yashkinsk and Rybnitsa plants, as well as at the Krasnoyarsk and Balakleya Concerns, domestic curing conveyors have been installed. They consist of two parts: the first, model SMA-245, with a length of 216 feet, is equipped with an auxiliary device for rotating the pipes in case of stoppage of the conveyor; the second, model SMA-246, with a length of 240 feet, has a similar roller bed but without this device. The new technological lines produce pipes according to the Technical Specifications TU 21-24-69-75 with a length of 16'-5" and with nominal diameters of 8"-20" for working pressures of 130, 170, and 210 psi. The wall strength requirements have been increased compared with GOST 539-73 for the 13'-1" pipes, and the inside diameter has been increased by reducing the wall thickness by 10-20%. The strength reserve, i.e., the ratio of the rupture pressure to the working pressure, has been maintained, in conformity with the ISO specifications, in the range of 3-3.5. The outside diameters of the 16'-5" pipes and of the standard pipes are the same, which makes it possible to use SAM or cast iron pipe sockets to join them.

During the start-up of the "Voith" line at the Zhigulevsk and Alekseevka Concerns in 1976, the optimal technological conditions, output, and the quality of the pipes were determined for different types of asbestos. It has been established that the hourly output of the new installation averaged 670 feet equivalents of pipe, which corresponds to an annual output of 1,641 yards equivalents of pipe. The replacement of part of the chrysotile asbestos (up to 25%) by crocidolite increases the rigidity and cylindricity of the molded products, and it is therefore possible to increase the thickness of the asbestos-cement film and the speed of the felt, which result in an additional increase by 20-25% in the output of the machine. The specific gravity of the 16'-5" pipes is within the usual range, i.e., .060-.067 lbs./cu in. Therefore, the high strength of the pipes is explained by the fact that the reinforcing properties of the asbestos are effective in the thin two-layered asbestos-cement film. This was demonstrated by the study of the structure of the two-layered film and of the pipe wall by a special x-ray apparatus. It has been established that the ratio of the number of asbestos fibers oriented in the direction of motion of the felt to the number of fibers oriented perpendicularly to this direction equals 1.22-1.47 in the film prepared in the "Voith" machine, versus 2-2.2 in the film prepared on the domestic machines, i.e., the orientation of the asbestos in each film of the 16'-5" pipes is less marked, but the number of films in the pipe wall has been doubled, which was responsible for the increase in the strength of the material.

The two-layered asbestos-cement film improved the homogeneity of the strength characteristics over the length of the pipe, as was demonstrated by the testing of 20 cut-out samples of the pipes.

The operation of the "Voith" installations put into service at the Korkino, Ivano-Frankovsk, Rybnitsa, and Kiev Concerns was studied. Here, using domestic asbestos, pipes are manufactured at a cloth speed of 120-130 feet/min; the thickness of the two-layered asbestos-cement film is .009-.010 inches. The results of the testing of the samples cut out of the pipes without preliminary water saturation are presented in the Table. The strength of the specimens is, on the average, 20% higher than is required by the Technical Specifications (7110 psi). The testing of the specimens from the production of the Korkino Concern showed that the ultimate tensile strength amounted to 3.270-3.480 psi following preliminary saturation with water and to 3480-3700 psi in the dry state (320 and 340 psi respectively, according to the Technical Specifications). Similar results were also obtained in the testing of specimens of the 16'-5" pipes manufactured at the Kiev Concern.

TABLE

Concerns (plants) manufacturing asbestos-cement products	Nominal diameter class	Specific gravity of the asbestos-cement, lbs/cu.in.	Ultimate crushing strength of the dry specimens, lbs/sq. in.
Kiev	20" 500, VT12	.0625	8460
	16" 400, VT9	.0645	8890
Ivano-Frankovsk	8" 200, VT12	.0635	9130
	8" 200, VT12	.0635	10765
Korkino	8" 200, VT9	.0650	7765
	8" 200, VT9	.0645	8435
Rybnitsa	12" 300 VT12	-	8150
	12" 300 VT 12	-	8945

The Alekseeva Concern was the first plant at which the production of pipes for a working pressure of 215 psi was started. During the manufacture of a pilot batch of pipes with diameters of 8" and 12", the hourly output of the machine averaged 885-920 feet equivalents at a felt speed of 140-150 feet/min. The pipes were at first cured for 5-6 hours on the roller bed at 120⁰ F, and then for 7 days in a basin at 70⁰ F. The physico-mechanical characteristics of the pipes with diameters of 8" and 12" and with respective wall thicknesses of 0.87 and 1.12 inches satisfied all requirements of the Technical Specifications. The crushing test of the water saturated specimens revealed an average strength of 7820 psi, and a strength of 8320 psi in the dry state. The specific gravity of the asbestos cement was .062-.066 lbs/cu. in.

The targeted output of the machine (690 feet equivalents) has already been surpassed at many plants. With rare exceptions, the automatic control instruments, hydraulic, pneumatic, as well as electrical devices operate reliably. The VNIiproekasbesttsement (All-Union Asbestos Cement Design and Research Institute) has compiled a parts list and instrument list from the domestic production as replacements for worn-out parts, instruments and devices of the "Voith" machine. The Institute has also calculated the technical-economic effectiveness of the reconstruction of the pipe-making shops of the companies on the basis of the installation of the new machines. The annual saving deriving from the reconstruction of one line amounts to 490,000 Rbl. The increased length of the pipes manufactured in the new installation, as well as their high strength make it possible to certify

them with the quality mark for a higher category. The advantages of the "Voith" installation, especially the twin-cylinder part of the pipe-forming machine, will have to be taken into account by the machine designers in the development of new domestic machines.