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Self-Unloading Vessel Equipped with Scholtz-EFS FLEXOWELL® Conveyor System

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Summary

The authors describe the introduction of the Scholtz-EFS FLEXOWELL conveyor system into the self-unloading vessel MV "AGAWA CANYON" which previously used a bucket elevator system for elevating material for discharge. The reasons for this conversion as well as the various erection stages are described. The newly equipped self-unloader was successfully unloaded under actual operating conditions for the first time on May 28, 1982. The capacity of the new elevating system was found to exceed the capacity of the former bucket elevator system.

1. Introduction

The development of new unloading technologies for self-unloading vessels, mainly on the Great Lakes, with rational systems which fulfill the ever increasing environmental demands, is a constant challenge for the engineer.

The elevating of bulk materials has always been a problem within self-unloading vessels where space is at a premium and unloading capacities are high. Bucket elevators were ideal for the application but were expensive, high in maintenance, noisy and extremely heavy. Despite these disadvantages elevators were used almost exclusively for many years and were installed with capacities up to 4,500 short tons per hour.

The Scholtz-EFS Conveyor System offers the simple advantages of the bucket elevator and a solution to maintenance, noise and weight problems.

In comparison with other systems, the cost of this elevating system is reported to be attractive. For the replacement of existing bucket systems, there are substantial cost savings to the shipping line whereby the owner receives a practical system which minimizes maintenance, increases the unloading rate, saves energy and virtually eliminates the noise caused by a bucket elevator.

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Algoma Central Railway's self-unloading vessel MV "AGAWA CANYON" (Fig. 1) commenced her regular cargo run on May 27, 1982 with her new elevating system designed and engineered by Scholtz-EFS, Hamburg, West Germany and Sullivan Strong Scott Ltd., Toronto, Canada. The FLEXOWELL® conveyor belts were supplied by Scholtz-EFS Corporation, Annandale, Virginia, USA (an affiliate of Scholtz-EFS, Hamburg).

In July 1981 Mr. John Madvig, Naval Architect of Algoma Central Railway's Marine Division and Mr. Gerald D. Sanderson, Manager of Engineering of Sullivan Strong Scott Ltd. travelled to Europe to view the vertical S-shaped and the CEWELL® conveyor demonstration plants of Scholtz-EFS in Hamburg.

After attending test runs with coal and limestone on both demonstration plants, both gentlemen were convinced of the function and capability of the Scholtz-EFS Conveyor System.

Fig. 1: MV "AGAWA CANYON" before conversion

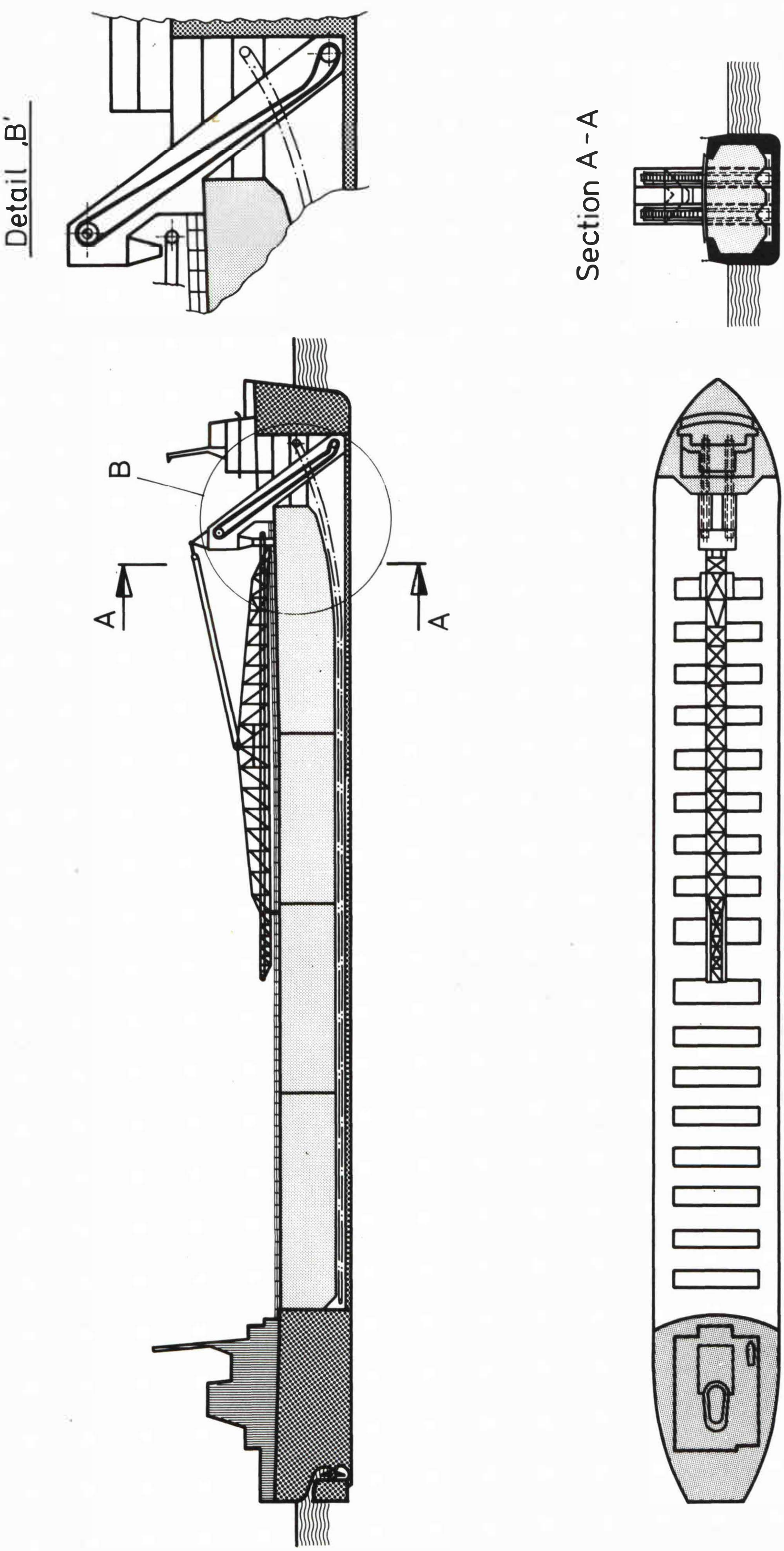

Fig. 2: General arrangement drawing of self-unloading vessel (Reference 270582/07087)

2. Advantages Over Elevators/ Conventional Systems

The following advantages over existing bucket elevator systems can be listed:

1. Lower maintenance costs
2. Less product degradation than bucket elevator
3. Can handle large lumps without damage
4. Environmentally more acceptable (less noise)
5. More reliable with a long life expectancy since all parts in contact with material are rubber rather than steel
6. Clean-up is virtually eliminated
7. Weighs considerably less than conventional systems and therefore allows shipping lines to carry more cargo per trip and use less fuel per trip when travelling light
8. Long life expectancy in comparison to elevator (major rework of elevator every three years).

3. MV "AGAWA CANYON"

In late July 1981 Algoma Central Railway's Marine Division requested a quotation for the conversion of one of their bucket elevator vessels, MV "AGAWA CANYON" (Figs. 1 and 2).

This self-unloading vessel has the following main technical data:

a) Design capacity

TPH	t/h	PCF	t/m³	m³/h	Material
3,000	2,720	50	0.8	3,400	Coal
4,200	3,810	100	1.6	2,381	Stone
4,200	3,810	125	2.0	1,905	Ore Pellets

b) Conveying materials

1. Crushed limestone
2. Calcite rock — 4″ (— 100 mm)
3. Coal
4. Coke
5. Salt
6. Gypsum
7. Iron ore
8. Iron ore pellets.

c) Designed to operate on a 2° list

In September 1981 Algoma Central Railway's Marine Division decided to place the official purchase order for the rebuilding of the vessel MV "AGAWA CANYON" due to the previously listed advantages.

4. Design Details

The complete system consists of the following parts:

Tunnel system:

Three 48″ (1,214 mm) wide tunnel belts, with a belt speed of 650 ft/min (3.3 m/s)

Elevator system:

Two 71″ (1,800 mm) wide tunnel belts, with a belt speed of 457.75 ft/min (2.32 m/s)

Boom conveyor:

One 250′ (76.0 m) long boom with a 60″ (1,624 mm) wide belt with a belt speed of 850 ft/min (4.31 m/s).

4.1 Tunnel Area

The design of the tunnel area is typical of all Great Lakes type self-unloading vessels whereby it utilizes gravity to feed the tunnel belts via a large number of gates.

Three tunnel belts, each 48″ (1,214 mm) wide, each being fed by 74 gravity type gates in selected order, are used to arrive at the required unloading capacity as dictated by the port facility, and to permit an even withdrawal from the cargo hold so as to avoid heavy loads on the structure of the vessel.

The tunnel belts bring the bulk material forward in the vessel to a point just aft of the collision bulkhead where the cargo is transferred by chutes to the new Scholtz-EFS Conveyor System.

4.2 Scholtz-EFS Conveyor System

The FLEXOWELL conveyor belts were chosen in accordance with the guaranteed volume capacity of 2 x 1,700 m³/h coal at 50 lbs/ft³ (0.8 t/m³) and the drive power was determined for a capacity of 2 x 2,100 TPH (2 x 1,905 t/h) stones.

With a medium angle of repose of 13° and a belt speed of 457.75 ft/min (2.32 m/s) the volume capacity of the FLEXOWELL belts amounts to 2 x 2,000 m³/h. This means that the total unloading capacity could be essentially increased, provided that the boom conveyor can handle it.

Two L-shaped FLEXOWELL conveyor belts are integrated into the existing steel casings with an incline of 54°. In order to have the conveying material arrive on the FLEXOWELL belts at an angle of almost 90°, coming from the chute (in free fall), the material discharge section was installed at an angle of 15°. After deflection via stub idlers, installed at a radius of 2,000 mm, the conveying strand is led upwards via straight pulleys at an angle of 57.59° (Fig. 3).

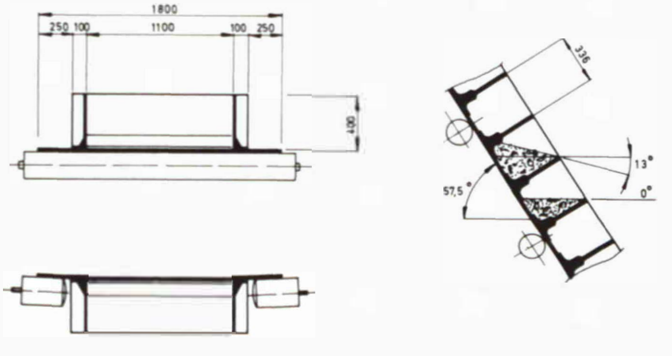

Fig. 3: Sketch of belt dimensions and cross-section

Due to parameters such as belt speed, pulley diameter and shape of cleats, the discharge of the material is effected by centrifugal force without problems. The energy of the discharge parabola is suppressed after approx. 1,500 mm by a rubber curtain.

The strand leading down is returned by means of stub idlers on the recesses of the belts at an angle of 55.22°. The stub idlers are installed angularly and thus provide a smooth return of the 1,800 mm wide steel cord belts type St 1000.

Shortly behind the discharge section a belt beater device is installed. This device can be operated when cleaning the belt is required, due to sticky materials.

4.3 Boom Conveyor

The Scholtz-EFS Conveyor System directly discharges the material onto a 60″ (1,524 mm) wide boom belt, mounted on a 250 ft (76.0 m) long boom for discharge to shore. This boom slews both 90° to port and starboard in order to feed the shore facility's receiving system.

4.4 List Control

In order to centralize the list of the vessel during unloading, the ballasting system is operable so as to limit the maximum list to 2° port or starboard and normally runs in the vicinity of 1° port or starboard.

Lights mounted on the house fronts both forward and aft permit the vessel's crew to visually confirm the list situation at any time during regular unloading.

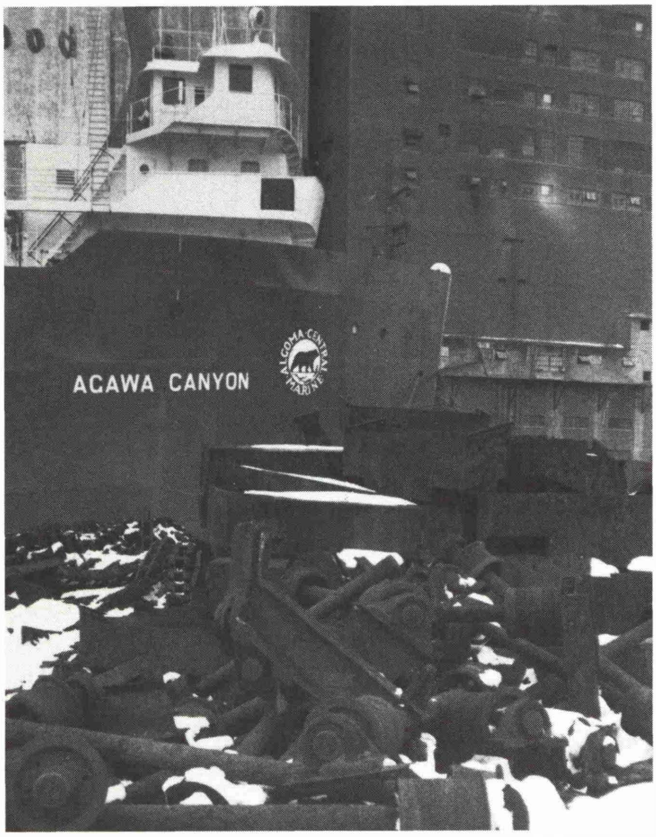

Fig. 4: Dismantled bucket elevator system

5. Rebuilding of MV "AGAWA CANYON"

On January 1, 1982 the dismantling operations of the bucket elevator system on board the vessel started. Stripping of the old elevator commenced mid January 1982. Subsequently the steelwork for the new system was installed.

The erection of the new equipment began in mid February 1982, and was undertaken by Herb Fraser and Associates Ltd. of Port Colborne, Ontario, Canada.

By mid March 1982 the first endless FLEXOWELL conveyor belt was installed under supervision of Scholtz-EFS, the second belt was completed by the end of the month.

Various Stages of the erection are shown in Figs. 4—12.

In April 1982 the equipment was ready for operation.

Recirculation tests at Port Colborne, Ontario, Canada with a cargo of stone took place on May 27, 1982 at which time the system proved to be fully operational and was committed for full service weith the Algoma Central Railway fleet.

For the recirculation test, the vessel was given a list of 3° in order to check the alignment of the system during its operation under full load.

The first full unloading took place the following day, May 28, 1982 at the Ontario Stone Dock in Cleveland, Ohio, USA, where the vessel's unloading system proved its design capabilities during the unloading of 21,028 short tons (19,076 t) of crushed limestone (Figs. 13, 14 and 15).

Following this successful unloading, a second cargo of 16,662 short tons (15,115 t) of coal was delivered to Marathon, Ontario, Canada on June 1, 1982 and the vessel is now on regular trade routes on the Great Lakes.

The capacity of the new elevating system was found to exceed the capacity of the former bucket elevator system, as witnessed by the unloading time for the vessel while in port.

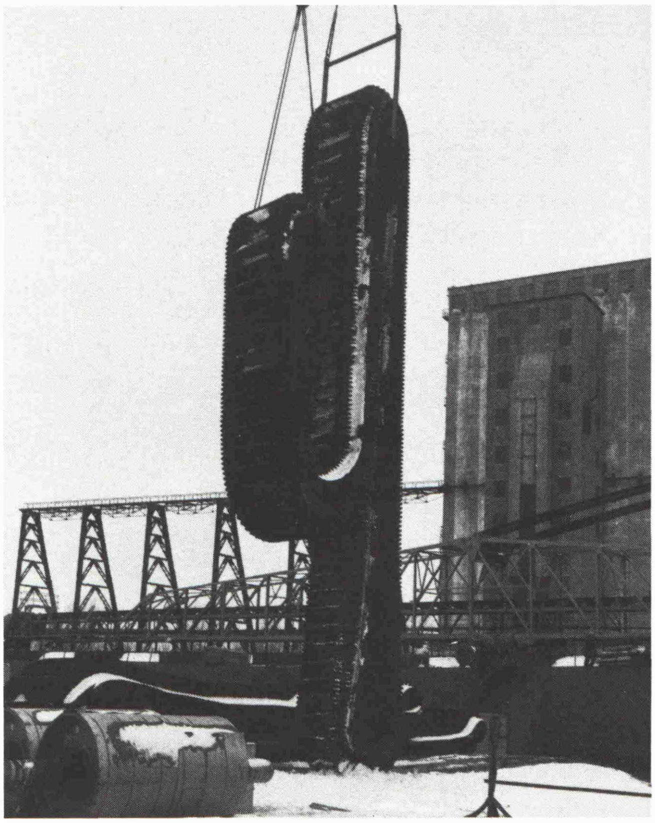

Fig. 5: The first endless FLEXOWELL belt in double loop on a landside crane which moves the belt to MV "AGAWA CANYON". On the floor on the left the second FLEXOWELL belt in loops. In front of the belts the two drive pulleys

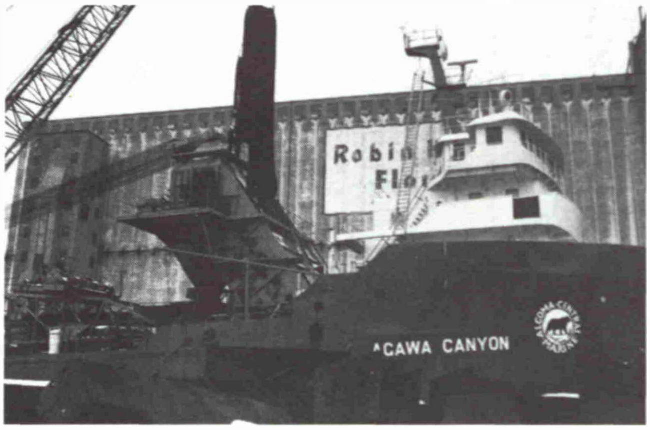

Fig. 6: The FLEXOWELL belt is lowered in an opening in the top part of the elevator casings onto the already erected stub idlers

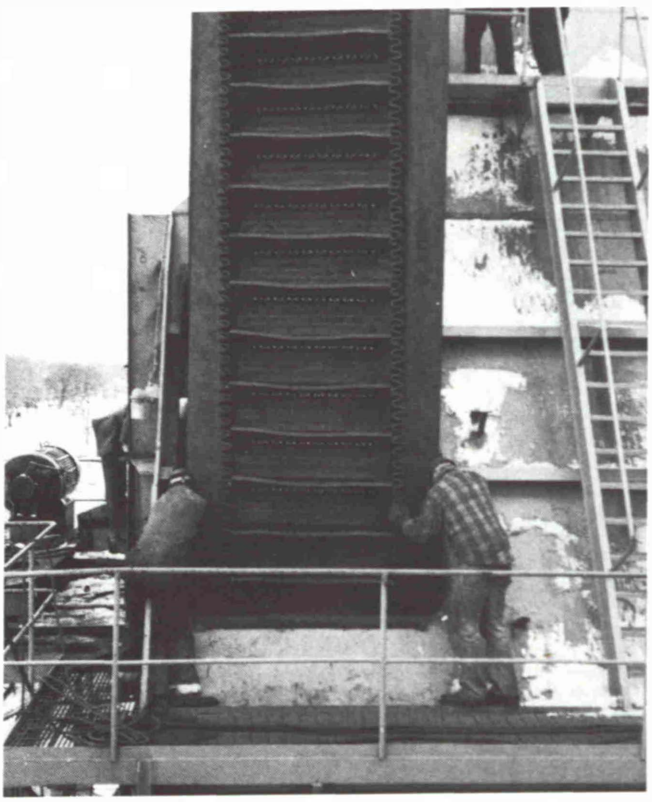

Fig. 7: Bespoke tailoring at insertion of the FLEXOWELL belt into the inlets provided in the steel casings

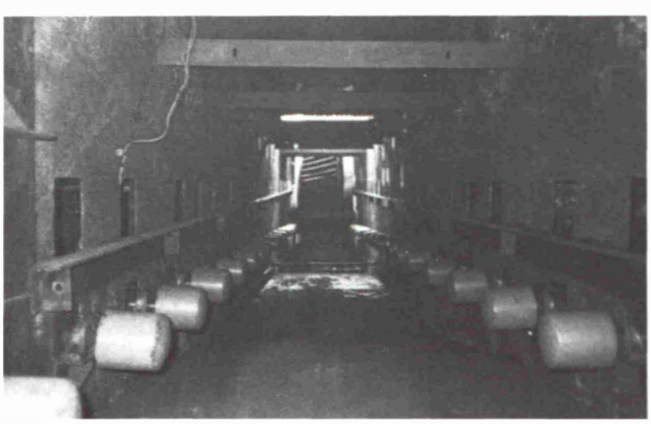

Fig. 8: View from tunnel level within the steel casings to the top. The cross-rigid FLEXOWELL belt is placed onto the inclined stub idlers with its recesses and smoothly slides down without further aid

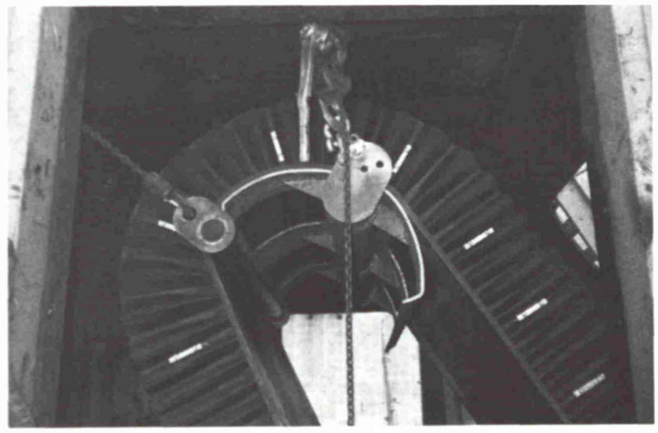

Fig. 9: In order to erect the drive pulley, the FLEXOWELL conveyor belt is pulled to the ceiling of the casing by chain

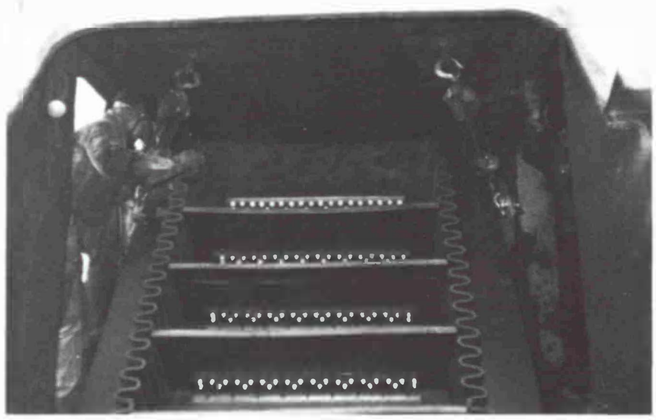

Fig. 10: The FLEXOWELL belt has now reached the highest position and is fixed with special supports

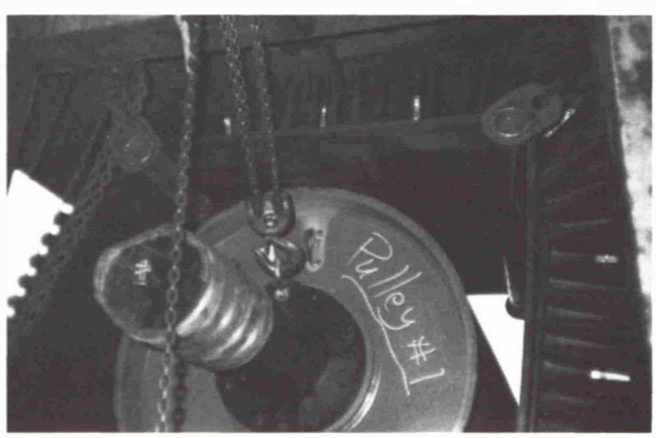

Fig. 11: The drive pulley is now in position, the pillow blocks are applied, afterwards the belt is lowered and then the entire system with the tail pulley is pretensioned

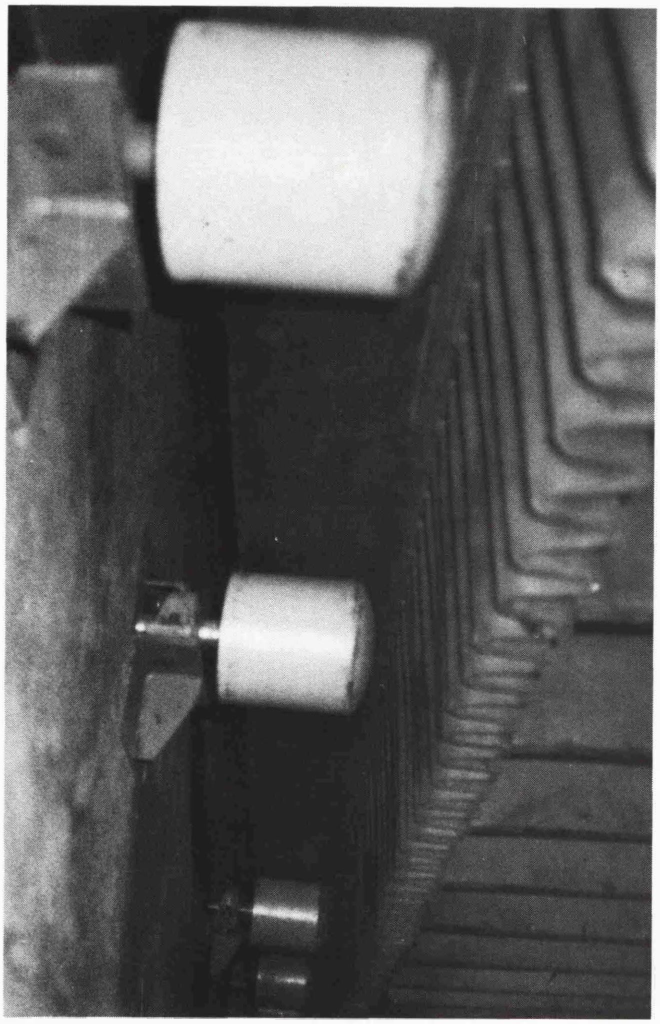

Fig. 12: Return of the pretensioned FLEXOWELL belt via inclined stub idlers

Fig. 14: View onto the discharge parabola during first unloading on May 28, 1982 with crushed limestone. Very clearly the photo shows the smooth removal of the wet limestone from each pocket. Due to the discharge by means of centrifugal force, it is ensured that no material is returned. Current requirement for the system while running without material: approx. 575 V 50 Amps (Amp.) and under full load approx. 160 Amps.

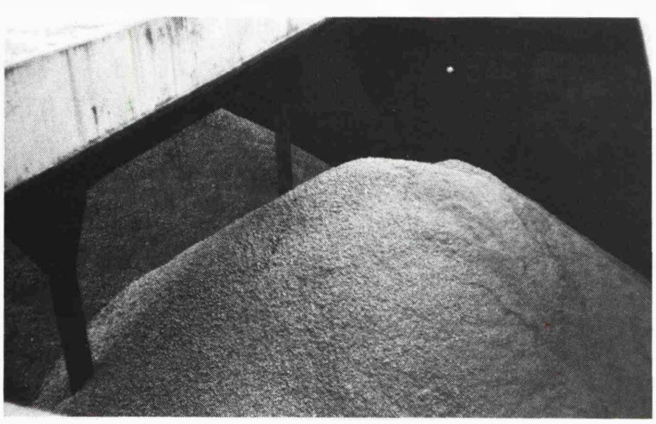

Fig. 13: View into the cargo holds of MV "AGAWA CANYON", filled with crushed limestone, on her first trip, upon arrival at Ontario Stone Dock, Cleveland, Ohio, USA, on May 28, 1982

Fig. 15: View of the material discharged (crushed limestone) by MV "AGAWA CANYON" during her first unloading at Ontario Stone Dock, Cleveland, Ohio, USA

At this time, Scholtz-EFS Corporation in conjunction with Sullivan Strong Scott Ltd. (the exlusive agent for Scholtz-EFS Corporation for shipmounted systems in Canada) would like to acknowledge that the decision to proceed with this project was made by Algoma Central Railway's senior personnel. It was a major decision and this success also belongs to them.

In summary, we believe that MV "AGAWA CANYON" is the first of a new breed of self-unloaders which will not only ply the Great Lakes of North America but also other trade routes in the world where such vessels will soon make their appearance.

Photographs: Scholz-EFS, Hamburg.