

Tubular Drag Link-Chain Conveyors

The Technology, Merits and Special Features

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Among the wide variety of conveying technologies available on the market today, engineers and purchasers must choose among pneumatic, mechanical conveying systems, each of which have their own merits and advantages; however, each application has its own requirements in terms of material handling and the appropriateness of each conveying technology. The technology on which this article focuses specifically is Tubular Drag Link - Chain Conveyors. It uses a link-chain which is automatically and continuously tensioned while the product is being conveyed – enabling the link-chain and the product to travel through multiple directional planes simultaneously using a single conveyor.

Anatomy of a Tubular Chain Conveyor

The Tubular Drag Chain Conveyor is an assembly consisting of a tubular casing through which a link-chain with circular conveying discs travel. The pockets formed by the spaces between the discs are reserved for the conveyed product, which is gently carried through the pipes to the discharge point. The system is driven and controlled by a drive station and tension station, which continuously tensions the chain in the conveying. The following are brief descriptions of major conveyor components: As shown in Fig.1

Drive Assembly – Consists of a sprocket, in a fixed position driven by a shaft mounted gear motor.

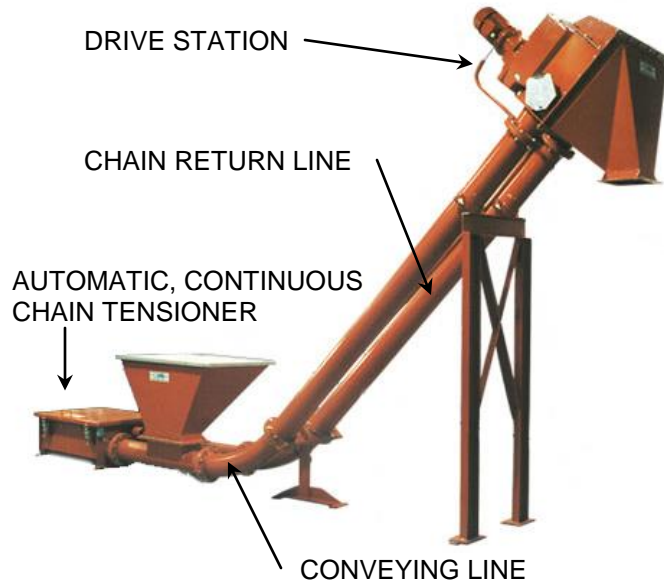
Tension Assembly – Consists of a sprocket, which acts both as an idler and a tensioner that automatically and continuously tensions the entire length of the link-chain during operation. It eliminates any slack in the conveying chain. The unit compensates for any increase in chain tension due to friction, increased flow rate, variation in atmospheric temperature, product temperature, chain and disc wear and tear, etc. The automatic chain tension design is important in order to minimize disc, chain and pipe wear. In addition, the chain return line is kept continuously in slight compression, during operation.

Link-Chain – The link chain design acts as a universal joint during motion and can turn in multiple directions and different planes.

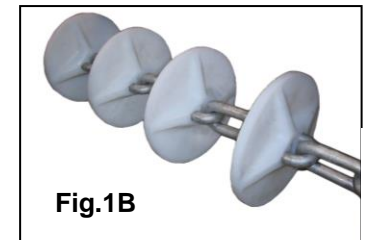
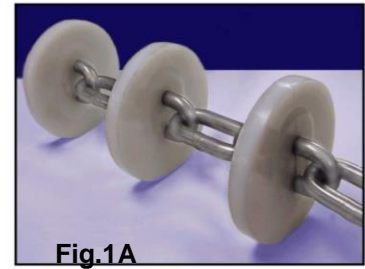
Conveying Disc-Chain Assembly – Consists of discs bolted or mounted to steel plates welded to the continuous case hardened link chain. UHMW, Cast Iron or polyurethane discs are typically bolted to the welded discs in two halves – split design. Two halves moulded discs (Fig.1B) are also used. The split design enables the maintenance crew to change only the bottom half disc which is subjected to wear and tear as opposed to changing the entire disc (double the expense) for a non split design.

Chain Assembly for Food Grade Applications - For wash down requirements, food and pharmaceutical, hygienic and sanitary applications, UHMW discs moulded as an integral part of the continuous polished Stainless Steel link chain (Fig.1A) are used. Twice the disc life could be achieved by twisting the chain by 90 degrees.

TYPICAL TUBULAR DRAG LINK-CHAIN CONVEYOR



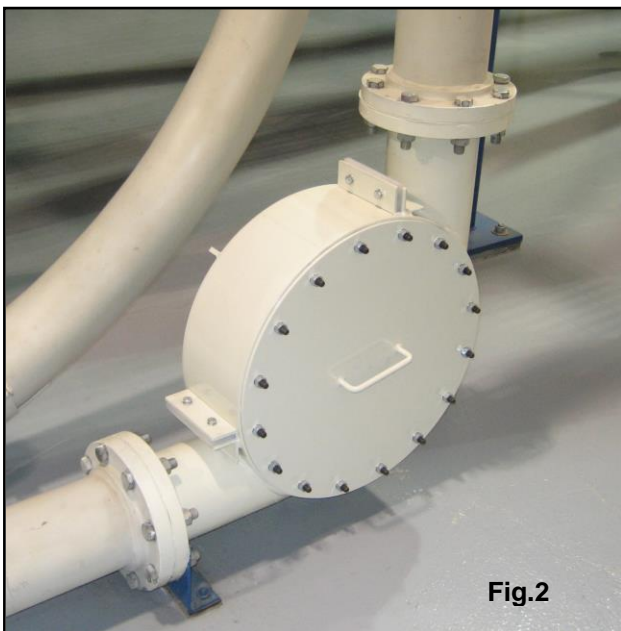
FOOD-GRADE,
SANITARY DESIGN:
UHMW- DISCS
MOULDED
TO POLISHED
SS CHAIN



TWO HALVES MOULDED
DISCS BOLTED

Brush Stations – Inline brush stations, integral drive-brushing stations are used to dislodge sticky, adhesive materials from the chain-disc assembly. This will ensure proper discharge and prevent cross-contamination between batches.

Turn Stations – In order to help the conveying chain travel through complex loop arrangements, driven and idler turn stations (Fig.2) can be located at strategic points in the conveying and return lines. This facilitates the chain and product to turn 90 degrees and significantly reduces frictional wear on both discs and pipe to increase component life. Turn stations are especially applicable with highly adhesive and highly abrasive products to minimize friction.



Determining Factors for Choosing Tubular Link-Chain Conveyors

- Designed to transport powder and bulk materials including food, flake, granular products, dust, sludge and hot and sticky materials.
- Dust and contaminant free conveying.
- No product degradation. The product remains protected and stable in the conveyor.
- Compact conveying envelope. A low profile, compact design for totally enclosed handling.
- The flexibility of the link-chain design with turn stations is used to detour obstructions caused by existing or fixed process equipment.
- Conveying of highly abrasive materials is enabled using basalt lined conveying pipes.
- Sealed conveyors for transportation of dust, gases and pressurized materials (certified)
- Conveying distances up to 180 feet horizontal and 120 feet vertical using one, single conveyor. For additional vertical or horizontal distances, multiple conveyors are used in series.
- Modular construction using interchangeable components allows the system to be expanded or modified in the future in accordance to any changes in the process.

Chain speed is adjustable using a variable frequency drive with a range of 4 feet per minute up to 88 FPM. The variation in chain speed enables the conveyor to gently handle fragile and delicate products without product segregation and degradation.

- Silo and bin loading is accomplished without product segregation.
- The conveying system is designed to stop and start at full load.
- The conveyors are designed to prevent product retention inside the system
- Continuous tensioning of the system performed by the tension assembly requires no manual adjustment, reducing the amount of labour required for maintenance.
- The systems are designed to minimize the impact of wear on components to reduce maintenance costs and production down-time.
- Tubular chain conveyors are designed for low energy consumption to create significant energy savings.

- The system is resistant to build up of internal pressure within the pipes due to explosion and contains any flame propagation (certified)
- Low consumption of Nitrogen for blanketing products, as per requirements.
- Rotary valves are not required for discharging dust collectors.
- The link-chain assembly with integral, moulded discs is ideally suited for Clean-In-Place, wash down applications as there are no cavities or hang-up points to retain the product.
- Hot products can be cooled during the conveying operation using conveyors fitted with specially designed jackets carrying a heat exchanging fluid.
- Patented inline 'LUXMIX' tubular link-chain mixers are used for continuous mixing, blending and conveying of multiple products without manipulating the product more than once.

Clean-In-Place (CIP) Applications

There is an increased demand in the market for complete wash-down of process equipment with minimum downtime and labour costs. The CIP tubular chain conveyor features the following:

- Specially designed quick-disconnect joints for easy assembly/disassembly, in order to provide a fully washable system for food-grade applications.
- Conveying integrated chain discs or moulded directly to the chain to eliminate hang-points where product may accumulate.

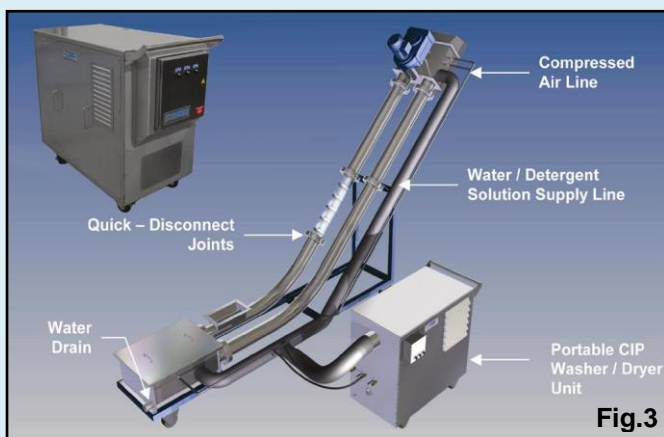
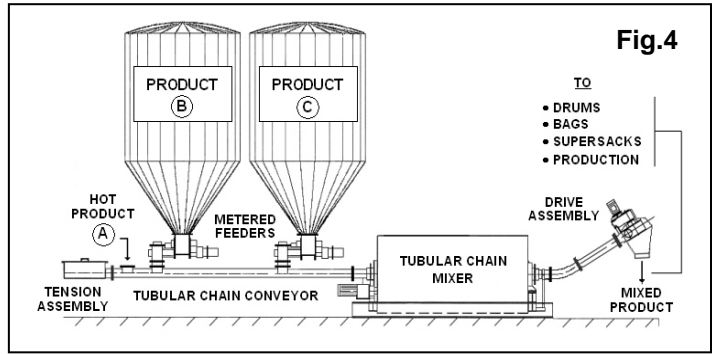


Fig.3

- Conveying discs are made from UHMW-PE – FDA approved, food grade. The conveying chain is made from polished stainless steel.
- The conveying pipes and stations have no hanging points for complete system washout.
- The drive and tension sprockets are either machined or moulded for sanitary applications.
- The numbers of joints are minimized as part of the CIP design. They are comprised of a quick-disconnect clevis clamp in order to ensure completely clean, product-free joints.
- The return line is designed to have the chain in compression (loose). This allows the chain to be cleaned thoroughly as the water is able to wash all surfaces of every link and disc.
- The CIP system is connected to compressed air and water/detergent/sanitizer solution sources.
- The system is designed to empty the conveyor using compressed air followed by flooding the system with the cleaning solution. These steps can be repeated cyclically until a complete washout and drying is achieved to have the conveyor cleaned for a new batch process.

Inline Tubular Link-Chain Mixers

The patented 'LUXMIX' tubular chain mixer provides continuous mixing of products. Different products are discharged into multiple inlets using metering screw feeders. The product is transported using a tubular chain conveyor to the mixer. The product is mixed before it is slowly conveyed to the process either for packaging, processing operations or storage. The mixing is totally enclosed, dust-free and eliminates downtime for loading and unloading to increase productivity in a compact arrangement.



Installations of Tubular Chain Conveyors



Truck Discharge to a Silo



Blender, Manual Dump Station Feed to a Wet Mixer in a height restricted area.

Comparative Power Consumption Analysis

An important consideration to any application is the operating costs with regards to power consumption. An example is illustrated below showing identical pneumatic and tubular chain conveyor systems using the same process equipment, identical conveying paths and distances. The process is the same for both applications, conveying product from a screener to a storage silo. The product characteristics are as follows:

Product: Wheat Flour
Capacity: 80,000 lbs/hr
Particle Size: 75 microns
Bulk Density: 40 lbs/cu.ft.

Operating: 24 hours per day,
 340 days a year.

Power Cost: 11 cents/kWh

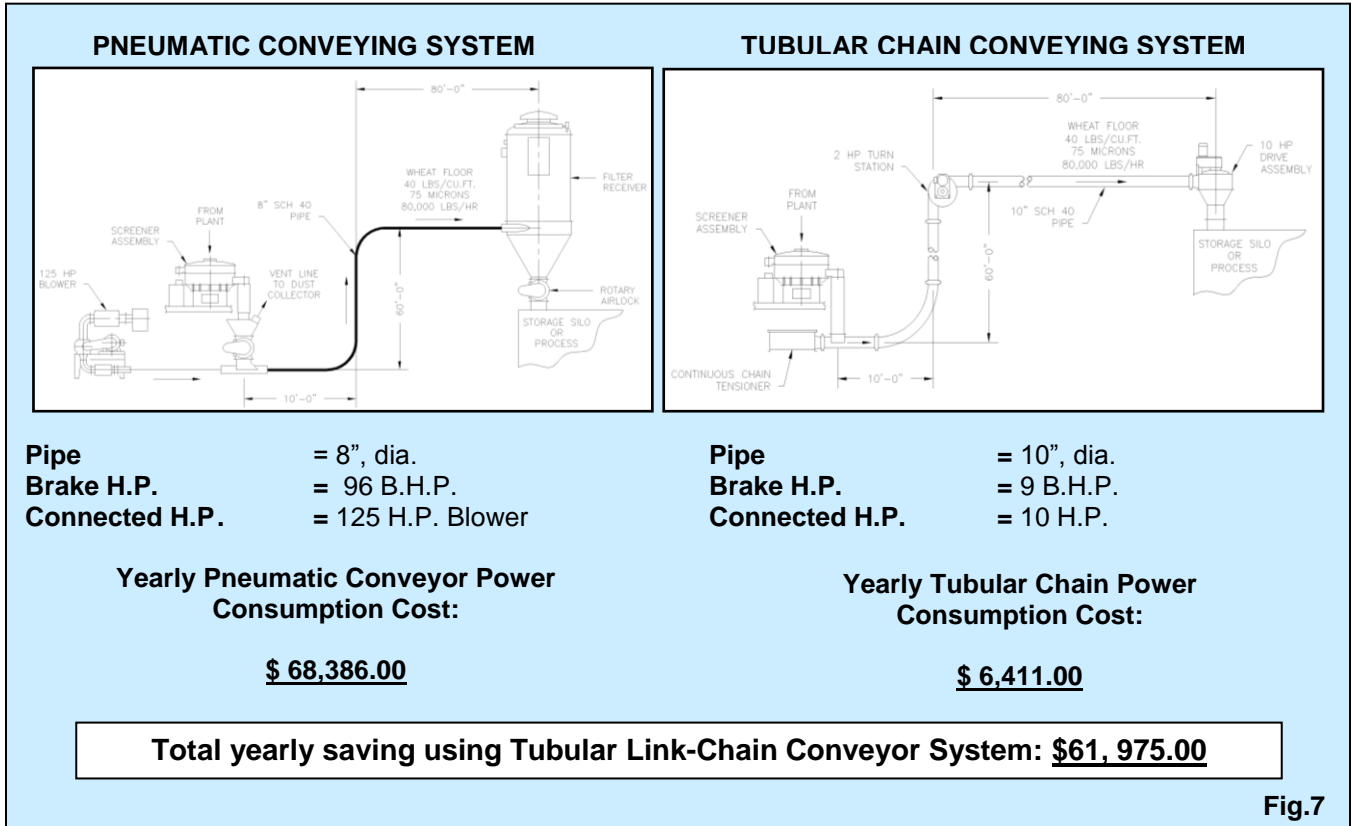


Fig.7

The total operating cost is a function of the power consumption costs as well as the yearly maintenance average costs.

In the case of tubular chain conveyors, wear items such as the conveying discs will require maintenance and replacement on typically a 2-3 year schedule based on the abrasiveness and physical attributes of the conveyed product.

It should be noted that experience dictates that in certain applications, no maintenance or disc replacements have been required for over 10 years as is the case with certain products such as milk powder, tea, sugar, etc.

In the case of pneumatic conveying, maintenance is required for the blower package, the dust filter, rotary valves and other moving parts.

Typical Layouts

