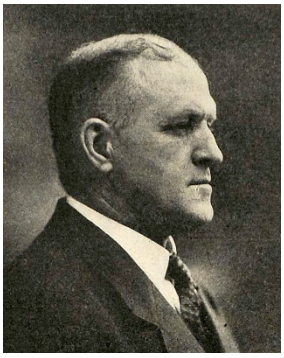
FULLER-KINYON® PUMP
100 YEARS OF RELIABLE PERFORMANCE

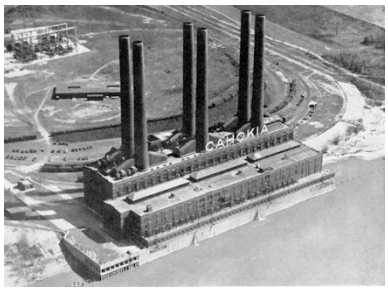
Humble Beginning: It's all about Safety



Alonzo G. Kinyon, Inventor of the Fuller-Kinyon® Pump

Conceived in 1918, the Fuller-Kinyon® Pump pneumatic conveying system was demonstrated a year later by Alonzo G. Kinyon of the Fuller-Lehigh Company. To address safety issues, Alonzo had developed some practical methods of burning pulverized coal in boilers and furnaces. In several states, legislation threatened the prevailing application of burning pulverized coal because of the extreme hazards in conveying it with mechanical conveyors. The FK Pump, as it is known today, was invented for the specific purpose of eliminating the fire and explosion hazard in the conveying of pulverized fuels.

Before the development of the FK Pump, the available conveyors for pulverized coal were mechanical blow tank systems. Pulverized coal was delivered by a mechanical feeder to the conveying pipeline. Blow tanks had the inherent disadvantage of intermittent operation and required high-pressure air. The use of double tank systems reduced the intermittent delivery problem, but made no substantial change in the dust hazard. Mechanical disadvantages included the space requirement, operating difficulties, including close supervision, and excessive wear on pipe bends. Fuller-Lehigh Company spent considerable time and money in attempts to develop practical blow tanks for pulverized coal. The company installed a few small systems. The only large system was installed at Cahokia Station, the principal public utility serving St. Louis. Wear of pipe bends was excessive, and introduced an additional dust hazard. In the mid-1920s, a Fuller-Kinyon pump replaced this system.



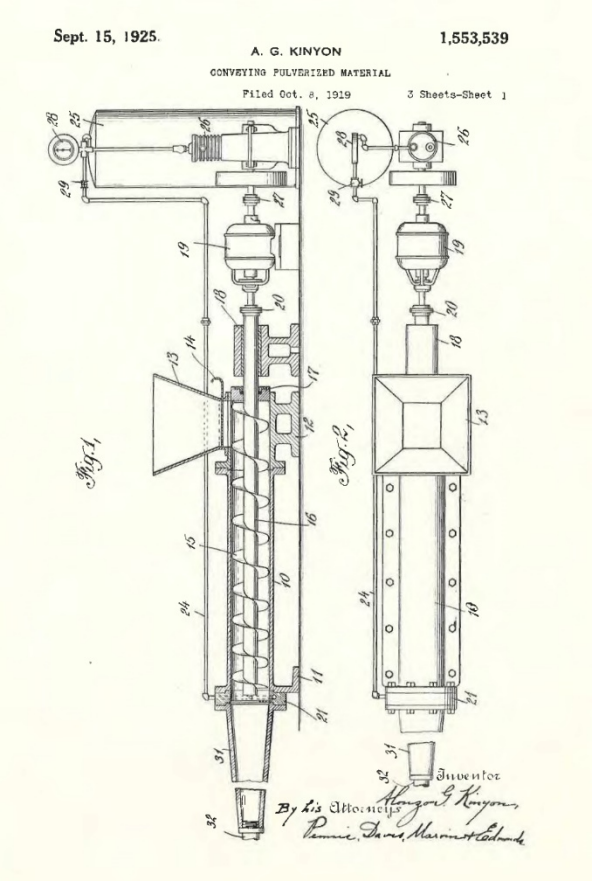
Cahokia Station Power Plant, St Louis, IL

It is especially tragic that Mr. Kinyon's only son and six other men were killed when a dust explosion occurred while they were installing an FK Pump to replace a mechanical system in a steel plant in Ohio.

A Few Words about the Technology

Based on the discovery by Alonzo Kinyon, the method of operation of the Fuller-Kinyon pump system is that dry pulverized materials assume a flowing, liquid-like condition when properly mixed with air. In this fluidized condition, pulverized materials can move through a pipeline as a relatively dense column, and at low velocity by the kinetic energy of expanding compressed air and the displacement of the material into the pipeline by the pump itself.

The original commercially successful Fuller-Kinyon pump is of Kinyon's patent 1,553,529, granted September 15, 1925 on an application filed October 8, 1919. It illustrates a conical screw and pump barrel as a second method of forming the positive seal or choke by increasing the pressure on the material conveyed. The obvious practical disadvantage of this design was that too many designs would be required to satisfy different field requirements.



Original 1925 patent

The second type of pump comprised a single screw with flights of decreasing pitch toward the discharge end to form the continuous positive seal or choke, and air was supplied through an "air-ring" beyond the terminal flight of the screw. This screw was cantilevered to operate under pressure as in the much later Type F and Type H pumps. It is noted that the three ways to form the continuous seal, whether used alone or in combination, were in the original Kinyon patent disclosure. No other method of forming a continuous seal has been suggested since this patent was granted.

With respect to the explosion hazard in conveying pulverized coal, calculations published in 1928 indicated that the maximum air requirement on existing pulverized coal systems was .0014% of the air necessary to support combustion. Following the conversion of the Fuller-Kinyon pump system to low pressure operation with air supplied by multi-vane rotary compressors (presently called Ful-Vane™ compressors), the air volume with relation to the coal handled was increased, but never exceeded 1% of the air necessary to support combustion. Early on, pulverized bituminous coal was found to be liable to spontaneous ignition when stored

in bins for about two weeks or more. As a result, many plants including public utilities, such as the Columbia Power Plant near Cincinnati, were deliberately designed to permit the withdrawal of pulverized bituminous coal. The pulverized bituminous coal had begun to burn to empty bins through Fuller-Kinyon pump systems, which extinguished the fire both by lack of air and some radiation losses.

Starch was conveyed experimentally for the A. E. Staley Company of Decatur, Illinois. Several types of starch were successfully handled during this experimental period. The program was started at the request of Mr. Chamberlain of the Staley Company following a dust explosion that killed 32 men at his plant. The success of the experiments resulted in the sale of numerous Fuller-Kinyon pump systems to that plant. Shortly afterward, a starch dust explosion at the Argo plant of Corn Products Refining Company killed seven men, and it also adopted Fuller-Kinyon pumps, which became common throughout the starch industry. Following the explosion at Argo, Dr. Price of the United States Bureau of Mines formed a special dust explosion hazard committee, which included representatives of the several companies concerned.

Mr. Kinyon was honored by several technical societies, and the Portland Cement Association described the Fuller-Kinyon pump system as the greatest contribution to cement manufacture since the invention of the rotary kiln. On June 2, 1926, the Franklin Institute of the State of Pennsylvania, acting through its committee on science and the arts, awarded the Edward Longstreth Medal to Mr. Kinyon for his new and important improvements in the art of conveying pulverized materials. All in accordance with the committee's report No. 2855 and dated June 2, 1926 and signed by Herbert D. Eglin, President, Howard McClenahan, Secretary, and Clarence T. Hall, Chairman of the Committee.

Founding of Fuller Company

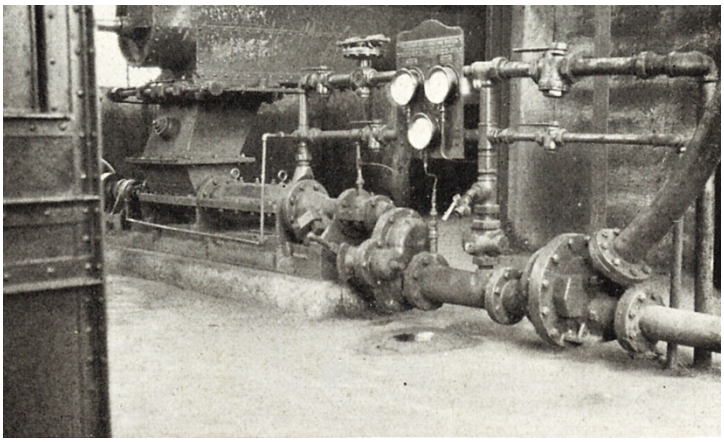
James W. Fuller, Founder

In 1926, Fuller-Lehigh Company was sold to Babcock Wilcox Company, whose engineers had erroneously concluded that the Fuller-Kinyon pump could not be used for conveying dense or more abrasive materials, particularly Portland cement. Colonel James W. Fuller, with tongue in cheek, accordingly retained title to the Fuller-Kinyon patents and products, but had to relinquish the right to use his products for pulverized fuel.

With no fewer than 18 cement plants placed in the Lehigh Valley within a radius of only 75 miles from his hometown of Catasauqua. James Fuller had long

ago realized that this industry was an important market base to work with and his patents had relevance to cement manufacturing equipment such as raw meal, clinker and coal grinding. In 1926, he formed The Fuller Company. He applied his patented products to the cement industry with the acquisition of the Fuller-Kinyon Pump (also very well known to FLSmidth) as the central product. From these core products, James Fuller developed the company into an engineering organization engaged in the design of many individual plants, including machinery supply, equipment and supervision of manufacture and construction.

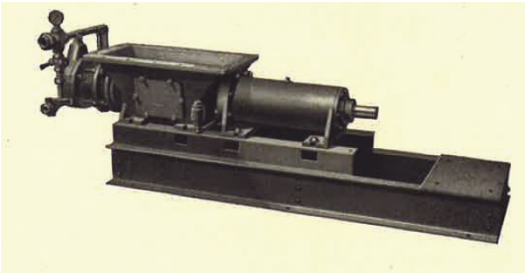
During the late 1920's, the Type 'A' through 'E' Fuller-Kinyon Pump was sold by Fuller Company. This design had a discharge end bearing but did not use a flapper valve. This pump required a one-way hand operated "SK" valve to isolate the conveying pipe for cleanout purposes.



Fuller-Kinyon® pump at Valley Forge Cement, circa 1929

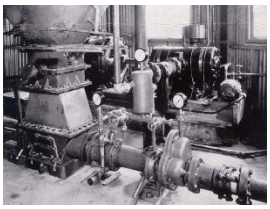
For many years, the FK Pump was the standard conveyor of the cement industry, which uses it to handle Portland cement, dry cement, raw material or raw meal, and precipitator dust. It profoundly changed the layouts of the cement plants constructed from about 1930 through the 1980s. Nearly forty years later, we still sell about 80 new FK Pumps every year to cement and minerals productions plants worldwide.

The Next Chapter: "Tween" Years



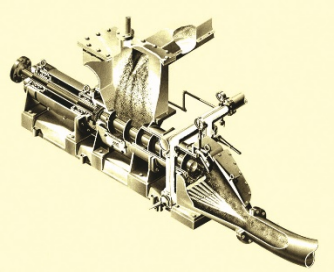
Fuller-Kinyon® Type 'F' Pump, 1931

1931: Type 'F' Fuller-Kinyon Pump - This pump was the first effort at using the overhung screw. The pump was designed with two bearings at the drive end of the pump. This pump used an air ring at the screw discharge without a flapper valve.



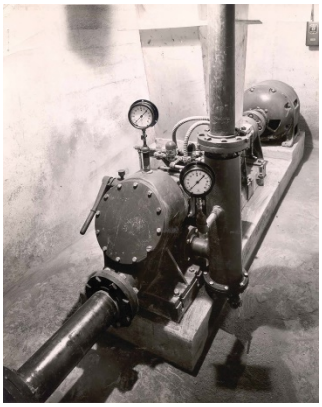
Fuller-Kinyon® 'H' Pump installed, 1935

1935: Type 'H' Fuller-Kinyon Pump - The current standard developed with the flapper valve, air nozzles and present windbox area design.



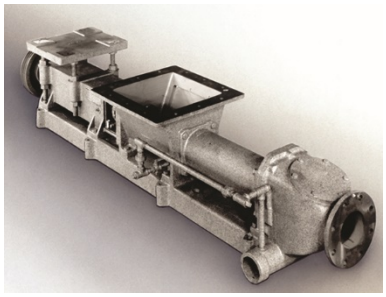
Fuller-Kinyon® Type 'H2' Pump, 1939

1939: Type 'H2' Fuller-Kinyon Pump - The 'H2' design increased the barrel length in the pump, which allowed the Fuller-Kinyon pump to operate against greater line pressures.



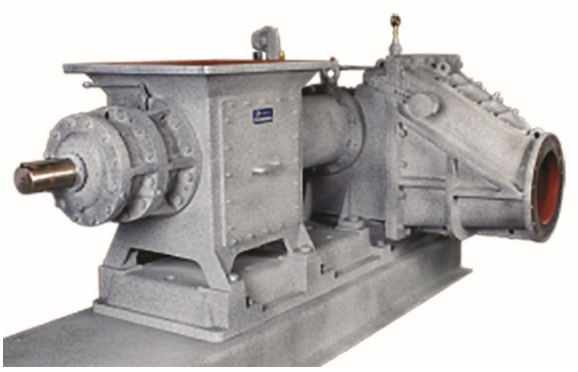
Fuller-Kinyon® Type 'L' Pump, 1947

1947: Type 'L' Fuller-Kinyon Pump - This design was developed with a shortened flapper valve body and a single air nozzle. This design was short lived, lasting only about three years. In 1950 the company returned to the Type 'H' design with a longer discharge housing and the standard (13) air nozzles.



Kompact™ 61V Pump, 1961

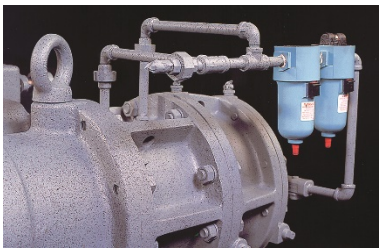
1961: Kompact™ Fuller-Kinyon Pump - This design was a light duty version of the Type 'H' Pump to be used for Ready-Mix plants to unload rail cars and transfer between truck loadout silos.



Fuller-Kinyon® 'M' Pump, 1976

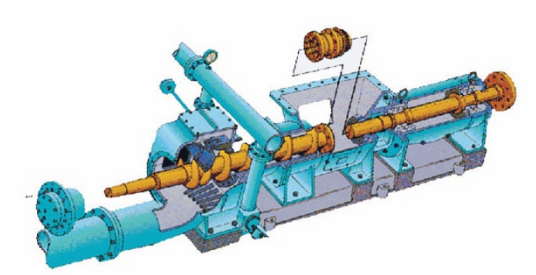
1976: Type 'M' Fuller-Kinyon Pump - A total redesign of the Fuller-Kinyon Pump, made metric and the elimination of the overhung screw design using a bearing at the discharge end of the screw. This is the current design standard.

1985: Z-Flap Conversion Kit - This conversion kit was produced as a means to provide a discharge end bearing for the Type 'H' pump design, eliminating the overhung screw design.



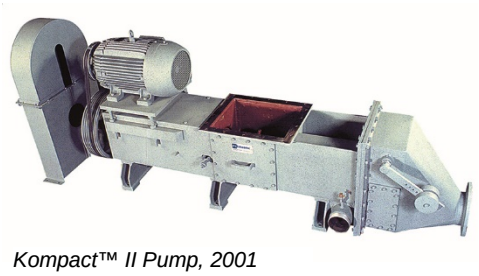
New pressurized bearing for Fuller-Kinyon® Pumps, 1989

1989: Pressurized Bearing – The pressurized bearing was adopted to the bearing design of the Type 'M' pump and the Discharge Bearing of the 'Z' Flap Pump as a means to prevent material from migrating into the bearing area and causing premature failure. This significantly reduced bearing failures which results in reduced maintenance cost and reduced pump downtime.



Fuller-Kinyon® 'H' pump with 2-piece screw and Z-Flap conversion, 1999

1999: Split Pump Screw Design – Another key ingredient to reducing maintenance of the Fuller-Kinyon pump was the adoption of the Split Screw Design. The Two-Piece design for the Type 'H' Pump and the Three-Piece design for the Type 'M' Pump were significant improvements to the Fuller-Kinyon Pump. This allows the customer to replace only a portion of the pump screw in reduced time and material cost. For the Type 'H' Pump, the split screw design allowed the reduction of spring tension of the graphite seal in the air-cooled seal assembly. This reduction of tension has extended the life of the graphite seal, again reducing operating cost for the customer.

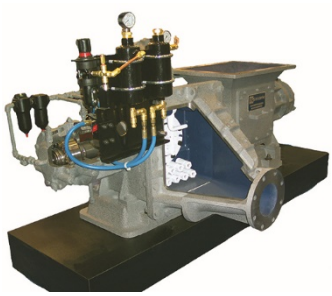


Kompact™ II Pump, 2001

2001: Kompact™ II Fuller-Kinyon Pump - The development of the Kompact II pump was to provide a higher capacity version of the 61V Kompact pump having a fabricated design for intermittent duty operation. The two sizes of pump maintain the same dimensional footprint with only the barrel size being different. Two Screw designs give this pump a range of capacity up to 150 STPH for finish cement.

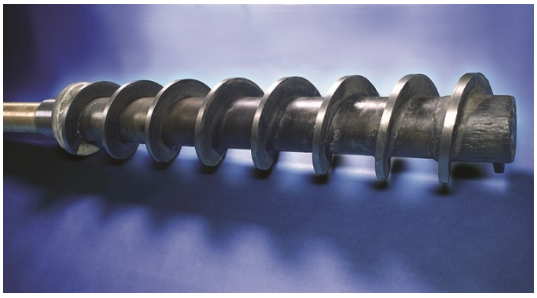
The Fuller-Kinyon Pump Continues to Evolve

Other improvements have been introduced to the Fuller-Kinyon Pumps to reduce maintenance requirements and improve the operating life. These improvements include the pressurized bearings for the Type 'M' Pump, Split Screw design for both the Type 'H' and Type 'M' pumps and the latest improvement being the "Pneu-Flap" torque controller.



Fuller-Kinyon® M pump with Pneu-Flap Torque Controller

The Pneu-Flap™ pneumatic flapper torque controller is designed to provide a constant torque through the full range of motion of the pump discharge flapper valve, thereby maintaining a good material seal at all times between the pressurized conveying line and the pump screw. Designed to be easily adjustable for the specific operating conditions, the Pneu-Flap torque controller minimizes component wear and improves the Fuller-Kinyon pump performance by optimizing the flapper valve torque.



Ful-Coat™ Silver Carbide™ Pump Screw

The Ful-Coat™ series Silver Carbide™ Pump Screw is designed to extend the life of Fuller-Kinyon pumps. A tungsten carbide coating is applied using our innovative application method, providing additional wear resistance. The FLS pump screw has 150% more hardened flights, 33% thicker side hard-facing, and 100% thicker face hard-facing than competing non-FLS pump screws. The FLS pump screw has a hardened steel sleeve and is engineered and factory-certified. Our tighter tolerances give our barrel liners, bearings and seals longer life.

FK Auto-Lube Pump Lubrication System

The FK pump Auto-Lube lubrication system is designed to deliver the precise amount of lubrication required for each FK pump while monitoring the bearing temperatures. The bearings, seals and blowout lever shaft are lubricated on an adjusted hourly interval. Due to the 2-liter capacity of grease, the FK Auto-Lube system can deliver up to 4 months of continuous lubrication between refills while continually monitoring bearing temperatures to prevent and reduce failures from improper lubrication. The FK Pump Auto-Lube system can be started either locally, from its panel, or remotely, using hardwired signals.

- Fred Wuertele, General Manager - Pneumatic Transport, FLSmidth Inc.