ISMA* Technical Meetings

Landskrona, Sweden
2-4 September 1947

**In 1982, the name of the International Superphosphate Manufacturers' Associations (ISMA) was changed to International Fertilizer Industry Association (IFA).*

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Landskrona Superphosphate Works.

In 1882 a company was formed at Landskrona for the production of sulphuric acid and superphosphate. The company started its production on an island called Green outside the harbour with a yearly output of 6,000 tons. In 1905 this factory was moved over to the mainland where it enjoyed an excellent position with ready facilities for loading and discharge. The works was given a yearly capacity of 30,000 tons of superphosphate and manufactured its entire demand of sulphuric acid.

Even at that time the factory was contributing to the solution of technical problems connected with the superphosphate production. Up till then the superphosphate had been mixed by hand and the slurry received run down into a chamber or "den" of brickwork where the solidifying process took place. Afterwards the block of superphosphate was removed by hand, a hard job detrimental to health, as all superphosphate manufacturers know, owing to the heat of the block and the acid gases. Mr. K.J. Boskow, then technical manager of the works, invented a mechanical den. He transformed the chamber into a car in which the solidifying process took place. When the block had been formed, the sides and front of the chamber were removed and the bottom of the car with the over-lying block was slowly pulled towards a cutting device. The first car was installed at Landskrona in 1909. The Boskow construction was adopted in many countries and is still being used in many of the largest factories in Europe.

Since that time the factory at Landskrona has been considerably developed, especially during the last decade, owing to its position on the deep harbour of Landskrona in the best agricultural district of Sweden. It now produces up to 240,000 tons of superphosphate yearly and is consequently one of the largest superphosphate factories in Europe.

Production at Landskrona Superphosphate Works.

The whole demand for sulphuric acid is being produced at the works, partly in a lead chamber unit built in 1924 and partly in a modern contact plant erected in 1944. The total yearly production of 100% sulphuric acid is 88,000 tons for which purpose 60,000 tons pyrites is burnt. The superphosphate is manufactured in a continuously working automatic mixing unit at 50 tons per hour with a capacity of 150 tons, so that a seasoning time of 3 hours can be allowed before the block is pulverized. This long seasoning time was necessary in order to make it possible to use apatite concentrates from Swedish iron ore mines during the War.

Besides these plants there is a phosphoric acid factory for 16 tons P_2O_5 per 24 hours, with rubber belt filters for the removal of the gypsum formed in the process. The phosphoric acid produced in this factory is mixed into the sulphuric acid in order to increase the content of phosphoric acid in the superphosphate, making it possible to use low-grade phosphatic materials. The degree of phosphoric acid in the Swedish superphosphates is comparatively high, about 20% water- and citrate soluble P_2O_5.

In order to facilitate transport to other works or for the production of double superphosphate the phosphoric acid can be concentrated in

evaporators of special design with heated air from the pyrites furnaces.

There is also a granulation plant with a top capacity of 25 tons per hour.

The continuous superphosphate mixing plant.

After several years of semi- and full scale trials a continuously working automatic superphosphate mixing plant was constructed by Nordengren. The plant was started in 1943.

The system is based on a discontinuous weighing and measuring of the raw materials. The ground phosphate is wighed in a reversible container or bucket hanging from a Toledo scales. On the scales is mounted a photocell arrangement, the rays of which can be shut off by a screen fastened to the dial of the scales. The ground phosphate is brought to the bucket by means of a large screw transporter which is stopped by an electric impulse from the photocell when the rays are shut off by the screen. At the same time a smaller screw transporter is brought into action, supplying the quantity of phosphate necessary in order to reach full weight, until the screen has passed the photocell, when a new impulse stops the smaller screw.

In the meantime a cast-iron bucket, mounted on a slowly revolving shaft has been dipped into a tank of sulphuric acid, of which a portion is withdrawn, the surplus being emptied over the sides of the bucket. If the weighing-in process has been completed the shaft moves on, emptying the sulphuric acid content of the bucket into a lower placed mixer. At the same time the portion of ground phosphate is emptied into the mixer with the aid of tools placed on another shaft rotating simultaneously with the first, the tools turning the bucket of phosphate upside-down. In this way a portion of acid and a portion of phosphate are brought together in the mixer. If, owing to lack of ground phosphate, the weighing-in has not been completed, both shafts are automatically stopped before the buckets are emptied; the shafts are also stopped if the level of acid in the tank is too low.

An intensive and rapid mixing is performed in the cast-iron mixer which is emptied after a few seconds as its bottom valve is automatically opened by the controlling shaft.

Originally the sludge coming from the mixer was let down into a reaction tray made of concrete and lined with acid-proof bricks. In this reaction tray were paddles of cast-iron mounted on a number of shafts, the paddles moving the reaction mass slowly from one end of the tray to the other from which it was emptied into a belt-chamber below. During its passage through this reaction tray, a period of 5 to 10 minutes, the sludge became more and more solidified so that it left the tray in a more or less solid form. - It has recently been found that this treatment in the reaction tray will be superfluous if the underlying belt-chamber is given suitable proportions.

The superphosphate is left to be seasoned in this belt-chamber for 1 - 3 hours, during which time the superphosphate block has been slowly transported towards a cutting device. The bottom of the belt-chamber consists of an iron segment belt of great width. The stationary side walls as well as the roof are made of concrete. The superphosphate coming down from the reaction tray is in a solid state and does not stick to the walls. - It has recently been found that, if the belt is drawn out backwards so that each batch comes down on a gentle slope running backwards, the slurry will not stick to the walls. Each batch will get only a small contact surface with the walls. In

this way it will be possible to eliminate the reaction tray and to let each batch run down directly on the belt.

The phosphoric acid plant.

High percentage phosphates are needed for the production of Swedish 20% superphosphates. About 20 years ago those phosphates were difficult to obtain and other means of making a high grade product were investigated. The possibilities of a direct production of a relatively concentrated phosphoric acid were studied, as this phosphoric acid could be mixed with the sulphuric acid for enriching purposes. During the research work different crystal forms of calcium sulphate were studied the anhydrate, $CaSO_4$, the hemi-hydrate, $CaSO_4$, $1/2H_2O$ and the dihydrate, $CaSO_4,2H_2O$, gypsum. Phosphoric acid was produced in autoclaves under pressure in such conditions that the calcium sulphate was formed as a hemi-hydrate, stable in the washing process. After some years, when the demand for phosphoric acid increased, the plant was rebuilt to produce the calcium phosphate as dihydrate in open vessels.

In the process the phosphoric acid had to be separated from the calcium sulphate by filtration. There was at that time (15 years ago) no filter suitable for this purpose so a filter of a new, original construction was invented by Wallny. The filter consists of a horizontally mounted rubber belt with upstanding edges carrying a second perforated rubber belt, which, in turn, carries the filter cloth belt. The primary belt, which is ribbed on its upper side and has a row of holes along the middle, runs over a suction box. The belt glides over this suction box delivering the filtrates into the box. There is a possibility of receiving a large number of fractions, if necessary. This filter is now in use in the phosphoric acid industry in many countries.

The phosphoric acid evaporation plant.

In the open vessels of the phosphoric acid plant now in action the phosphoric acid produced has a concentration of 30% P_2O_5. If this acid should be used for the production of double superphosphate it ought to be concentrated. A simple design of an evaporator for phosphoric acid has been carried out. The heated air from the coolers of the pyrites furnaces is blown at a temperature of about 200°C with the aid of a ventilator through mouth pieces sticking down into the phosphoric acid. The air has a great velocity but a comparatively small pressure. The evaporator is formed as a long box with air mouth pieces of 4" lead pipes sticking in at one of the longer sides; the weak 30% P_2O_5 acid comes in at one end of the box and leaves it as 50% at the other end. When the air is pressed through the acid a large contact surface is formed and the solids precipitated at the concentration process are, as a rule, received as a suspension; they are removed with the concentrated acid to tanks where they are separated from the acid through decantation. The mouth pieces are easy to clean.

The granulating plant.

The problem of making superphosphate in a granulated form has been studied at Landskrona for many years and several pilot plants have been in action. The present plant was erected in 1941 but it was impossible to get it into action until 1946 as the superphosphate, produced from the Swedish apatite concentrates, had a very high degree of iron and was too tixotropic to be used with advantage. The plant has a top production of 25 tons per hour. It has

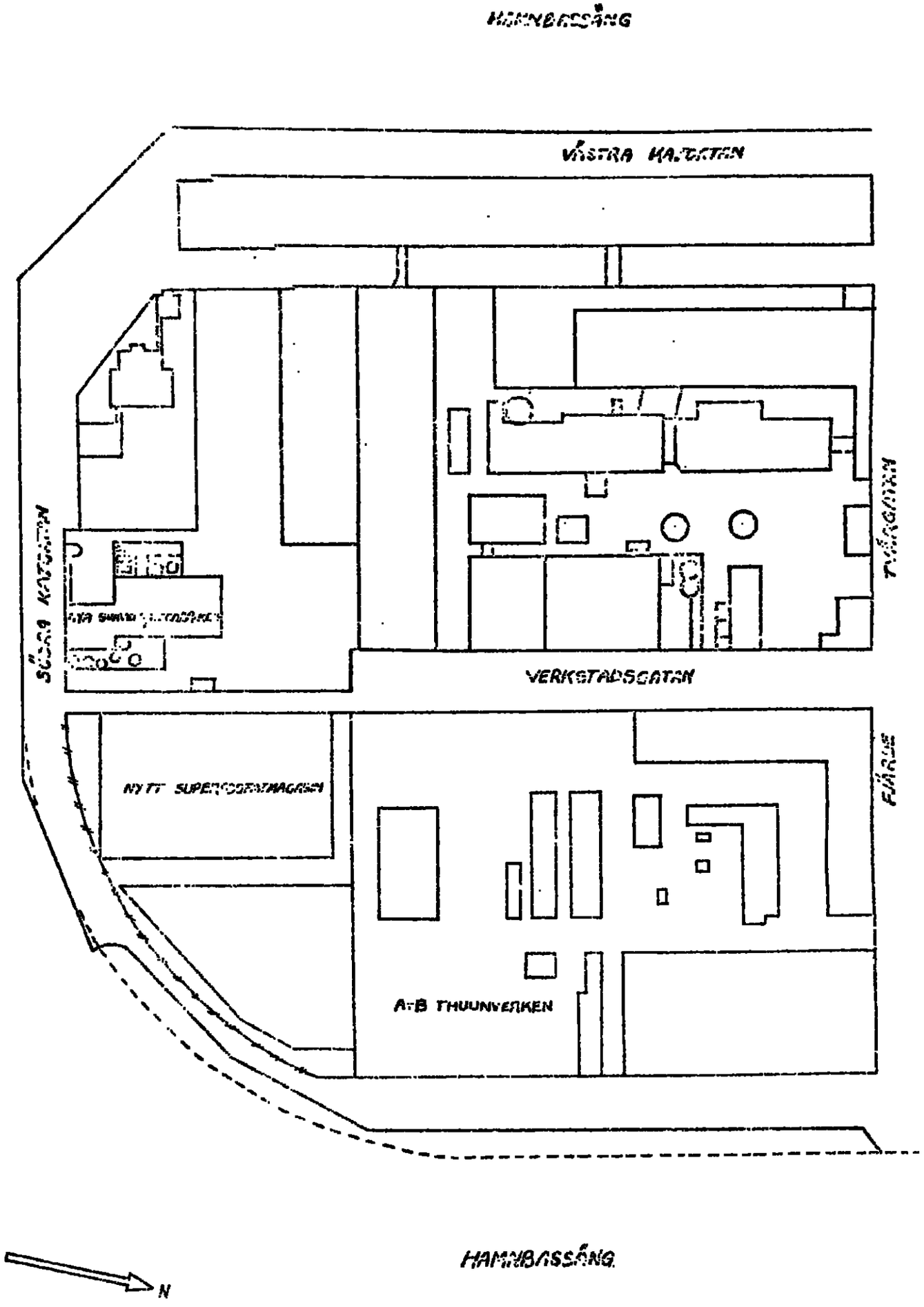
been found that granulating plants should have a high capacity in order to function economically. In the process comparatively freshly mixed superphosphate is being used and provisionally the pulverised superphosphate to be granulated comes from a store house nearby. The granules are formed in a rotating drum in which the superphosphate is treated by shovels mounted on a shaft rotating in the opposite direction to the drum. Water is sprinkled into the drum and its supply is carefully regulated by hand. A scraping device for the walls of the drum has been installed and is put into function from time to time as need be.

From the granulator the moist granules are passed on to a rotating dryer and from this dryer to rotating screens in which the finer particles are removed and returned to the granulator. The product is then separated from the over-sized particles and brought to the store houses. The oversize is crushed in roller-mills and the crushed product passed through a classifier of a new design, a combination of a transport belt and a rotating cylinder which has given very good results and in the future may well make the rotating screens unnecessary.

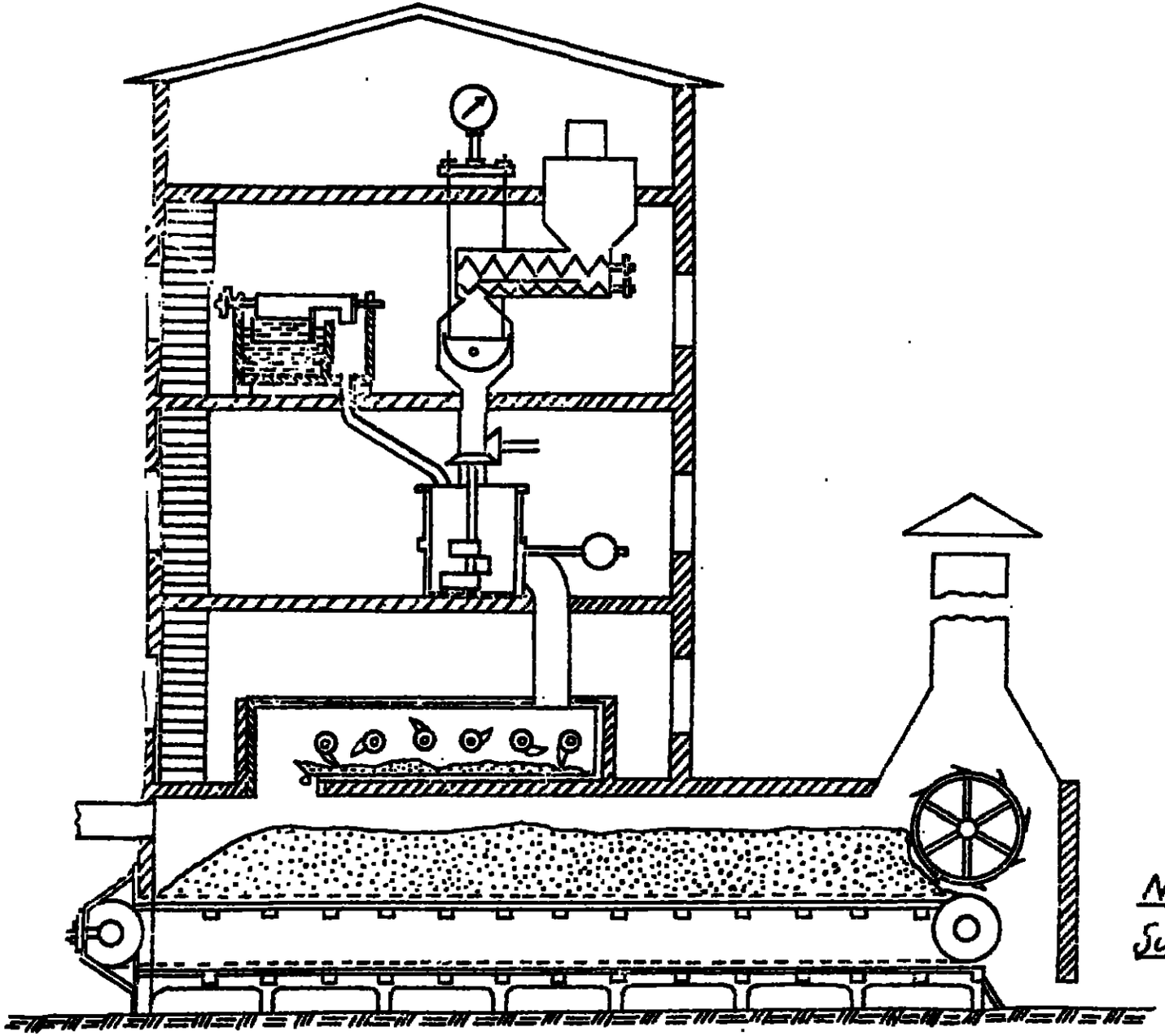
Research department.

A research department has been established to take care of the different problems connected with the production. It works under the name of Aktiebolaget Kemiska Patenter, a company wholly belonging to the superphosphate works. Although mainly working on problems connected with apparatus construction, it has also laboratories for the chemical research connected with this work. Suitable localities for large-size trials are available.

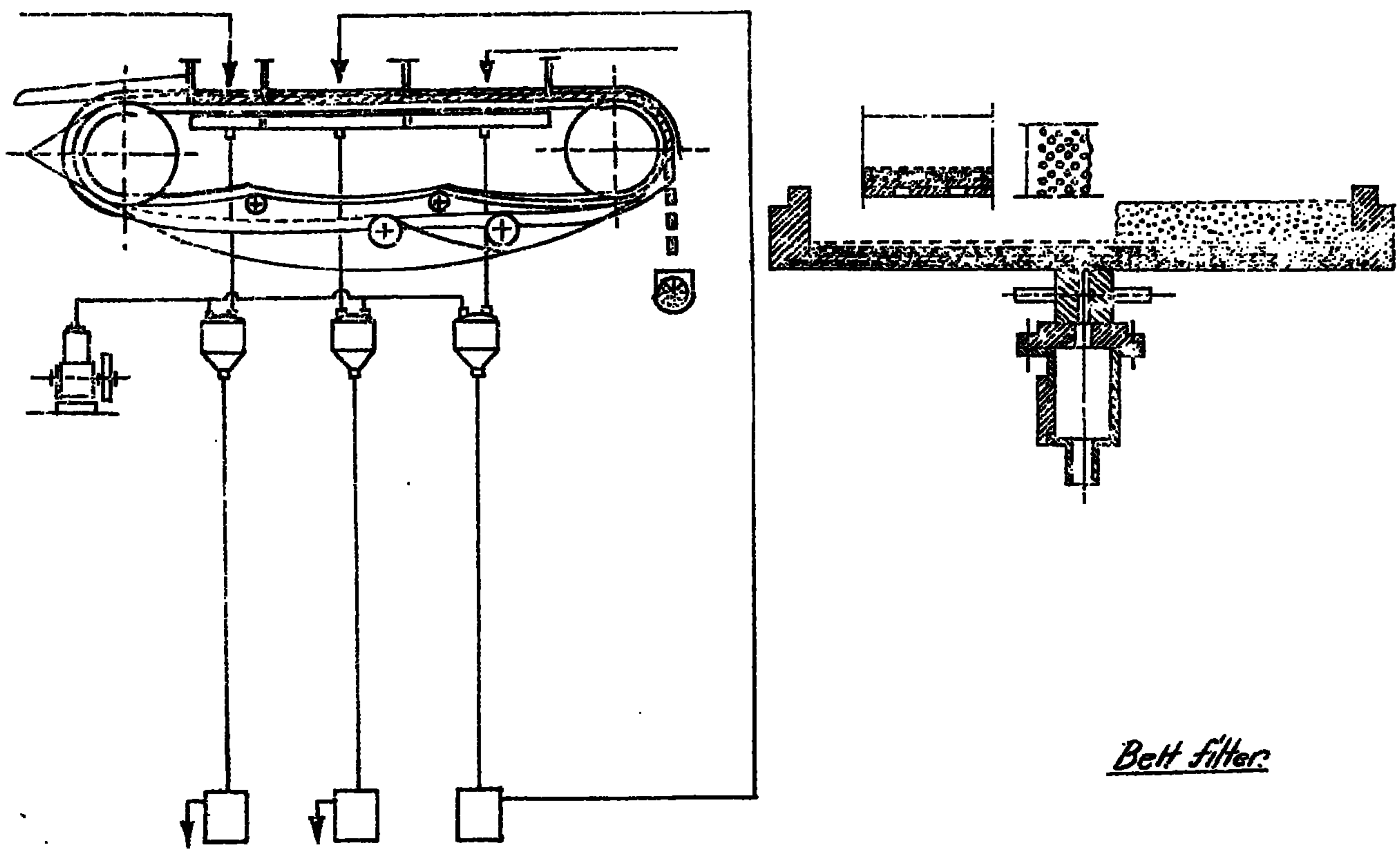
September, 2nd, 1947.



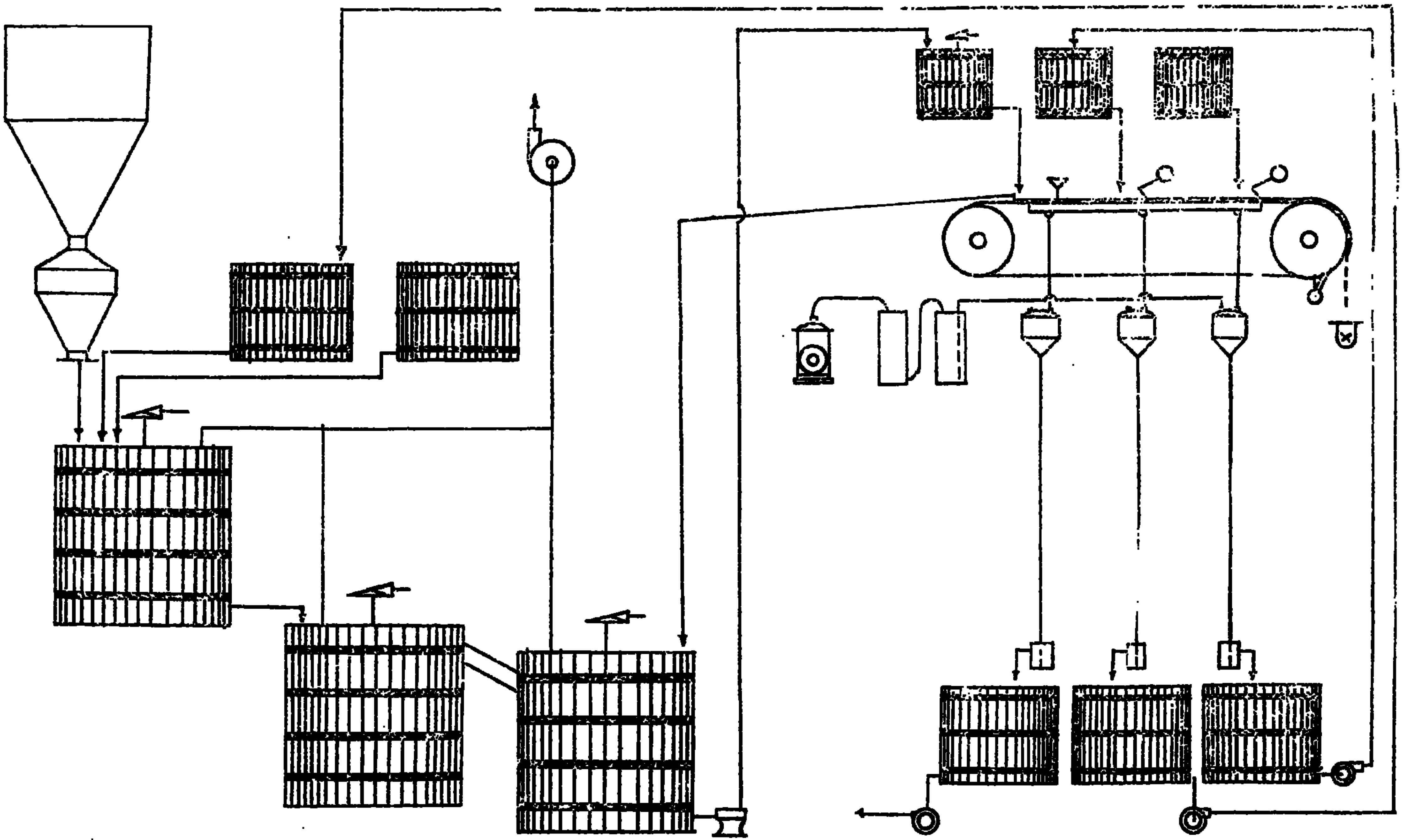
Plan of Landskrona superphosphat works



Nordengren Continuous
Superphosphate Process



Belt filter.



Phosphoric Acid plant