THE LATEST RESULTS OF THE HUNGARIAN MILLING MACHINERY PRODUCTION

by

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Hungary has considerable traditions in the field of milling machinery production, and in fact, it was practically Hungary where from the rollermill, plansifter and purifier started to conquer the world. Hungarian milling machines have always excelled by their special design and adaptability to technology. Recently, a new upward trend in the Hungarian milling machinery production can be observed; old machines are replaced by new ones to meet the special requirements of modern milling industry. These new machines of Hungarian origin differ in design from the usual types of European milling machines, and are adapted to the new higher claims in the technology of grinding.

The first and most important machine of milling industry is the rollermill (Fig.1). The Hungarian one differs considerably from similar rollermills used in the Continent. It is characterized by having its rolls in horizontal arrangement, which renders possible a higher specific output of the rolls. Horizontal roll-arrangement is traditional in Hungary, though there has been some production also of rollermills with rolls arranged diagonally. A large number of comparative tests have been made in this field to state the importance of arrangement of rolls concerning the output and production of the mill. The long tested period showed unambiguously that horizontal arrangement of the rolls makes possible a higher output than diagonal arrangement, which is seen best from the fact that feeding can occur in the former case without such as the use of feed plate, etc. by adding the material directly in between the rolls. If the speed of rolls and the grist are the same, and all characteristics of the rolls are identical with the diagonal system either the reduction is lower at the same output, or supposed that the reduction of both roll systems are identical — the output of rolls of the diagonal arrangement will be lower; the finer and more difficult to draw in the grist to be processed, the greater the decrease. The difference of output between the two roll systems is higher than 10%. Another advantage of recent Hungarian rollermill is that it was produced from such materials and by such technique, which eliminate the usual unequal deformation of the rolls along the generatrices. Unequal deformation of the rolls is due to the fact that the material of the rolls is not tight, thus expansion may occur in the central part of rolls both inwards and outwards, while on the ends at the hubs only outwards. For this reason it is customary to use a stronger working off at the ends of the rolls, i.e., the rolls are ground to be slightly convex; however, this practice gives inaccurate rolls, since the grindstone is regulated by hand. It is quite obvious that parallelism of a pair of rolls made in this manner is highly dependent on temperature, since the expansions are different. It follows that in this case the precision of grinding can not be the same as that of a roll which expands uniformly along its generatrix to give a correspondingly uniform grinding.

In the course of further development, the next problem solved was to keep the working surfaces of the rolls running cool; under normal conditions, even if the specific output is large, the temperature does not exceed 25—28° C. This is of tremendous importance, especially when processing wheat of poor quality. It is a known fact that the process of grinding, due to the evolution of heat, exerts detrimental effect on the quality of flours of the last systems. It is known to all experts that gluten can not be washed out from the last breaks or from the white flour of the last or frequently from the next to the last system when grinding is done with warm rolls. Yet the biggest trouble is caused not by the loss of gluten in the flour, but by the lowering of quality of gluten to such an extent that it will be converted in the last system to a flat form; this could be confirmed also by instrumental testings of flours. The lowering of quality originating from the warming of rolls is attempted to be eliminated through cooling the rolls with water, as it can be seen in some rollermills, but this solution is expensive, because it requires a pumping installation and in addition, water, which is not available everywhere. It is better to solve this problem, like it is done in Hungarian rolls, by eliminating the cause of the trouble, than try to remove the heat with water from the rolls.

constant opening the fixed grinding nip between the rolls is a highly advantageous feature of the Hungarian rollermill in so far that the highest requirements can be satisfied and as a result, greatly increased output of grinding and uniform processing can be achieved. The roughness of surface of the plain rolls influences their operation in a

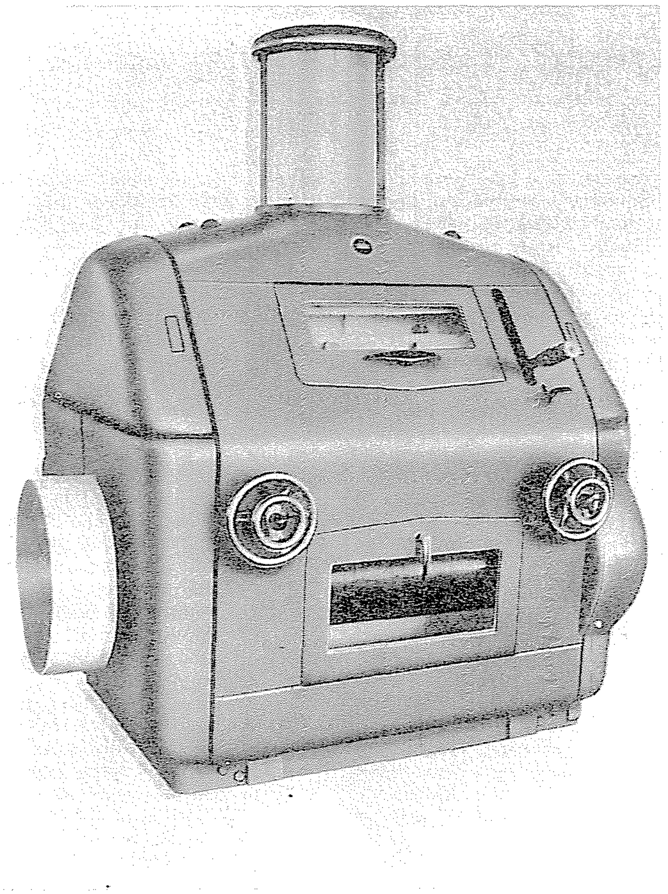


Fig. 1

A further advantage of the Hungarian rollermill is that the strain of power required to press the rolls together is not thrown to the framework of rollermill, but the break rolls are held together in a closed kinetic chain; thus perfect parallelism is secured, and as said, the pressure of grinding is not transmitted to the framework of rollermill. In this way it is assured that if some rather large foreign object happens to get between the rolls, it cannot cause a breaking in the delicate construction of the rollermill. Securing the

decisive way, and affects the quality of flour processed on them. Namely, the smoother (so-called: dead smooth) is the surface of the roll, the more heat will be received by the grist and the greater the grinding pressure required. The working surfaces of the new Hungarian smooth rolls are delustred by a special treatment, and this delustre is retained by them for a long time. By this means in a simple passage substantially more flour can be obtained at lower grinding pressures, than if the surfaces have only usual roughness.

To improve the performance of the rolls, roll cleaning scrapers which have been used until now and have contributed to the warming of the rolls as well as to the increased iron contents in the flour, are eliminated. The new Hungarian rollermill has other distinct improvements too, e.g. the obliquity of the feed plate, i.e. the angle of drawing in the feed is adjustable according to requirements of various types of grists. The speed of feed rolls can be regulated as it is needed for grists to be ground.

At the customer's request the rollermill will be fitted with a controlling servo-mechanism with the purpose to release the rolls from grinding distance, i.e., to set automatically a wider opening between the rolls and to stop the supply when the flow of stock is interrupted. In turn, when the stock starts again flowing, the servo-mechanism puts on the rolls, i.e., adjusts the opening between the rolls to the correct width and at the same time an electric light-signal together with an acoustic one is given at any place where required, even in the office of the manager.

The construction of the rollermill has an attractive form and its handling is very simple. This design renders possible to combine them in an assembly having a common drive; in this way transmission is not necessary. The rollermill is fitted also with a manual switchgear. Recent design is especially promising to afford high extraction rates of white flour, as required by millers.

Figure 2 shows a cross-section of the new rollermill. This rollermill is available in the following sizes:

diameter: 220 mm or 250 mm, length: 600, 800, and 1000 mm. The weight of the 220/1000 mm machine amounts to 2660 kg and that of the 250/1000 mm size to 2850 kg.

The second main-machine of flour milling is the plansifter.

Recent Hungarian plansifter is another milestone in the road of improving the machinery of the milling industry. The new plansifters are characterized by having metal housings, and the frames of sieves are set in self-carrying houses of metal construction. The flour output of this new plansifters is 2.5—3.5 times higher than that of the plansifters of older types. The coarser the grain of the grist, the higher is the specific output of the sifter. The outputs in sifting of coarse breaks are 3.5 times higher, and that of soft middlings 2.5 times higher with recent Hungarian plansifters. Thus this machine has in respect of output considerably higher performance than any other sifter of similar design.

This plansifter can be considered — owing to its high output — as the sifting machine of large mills. In milling of 1 metric ton of wheat it was required earlier to use 2.8—3 square metres of sifting surface. The specific output of the new Hungarian plansifter is 0.6—0.8 square metres per metric ton of wheat. By using these plansifters the mill can choose the number of separations at will, i.e. as many separations can be taken as it is required by the conditions of milling. The number of sieves can be varied in the plansifter between 16 and 27, in contrast to earlier plansifters which had only 8—9 sieves. This change means in practice that when sifting a grinding system, for example of a break system, the number of separations is maximized to 9, i.e., one coarse transient, one fine transient, one coarse semolina, two medium semolina, one fine semolina, two middlings and one flour extractions are taken. In that way the mill can form such a wide scale of grading which makes possible to separate the grist not only according to size but — if the silks are properly chosen — also according to specific weight; hereby the process of purifying can be simplified in the mill, and in the case of milling soft wheat it may sometimes be entirely omitted.

The cleaning method of the new plansifter is far simpler than the brush method commonly used in Europe, for it employs cleaning clogs and swabs depending on the required degree of cleaning.

Another advantage of the design of the new Hungarian plansifter is that all sieves have the same size and identical inner arrangement, moreover the frames are identical too, so that the miller can change the diagram of the mill — even during operation — by building in a simple pipe or by replacing the old pipe with a new. If sieves break down while running or if the cover needs replacement, the frames can be changed or new silks may be introduced in a very simple way.

In the plansifters of recent design, the movement of grist is considerably different from the material handling of earlier plansifters. Formerly the grist moved on the cover in a circle corresponding to the sifting strokes, decreased by the friction coefficient, and it travelled around on the silk with a velocity over 0.5 m/sec. In contrast to that, in the new plansifter the grist moves more slowly, with a velocity of 0.1 m/sec. Thus it can not happen — what has been characteristic of plansifters of the earlier design — that when the layer of grist was thin, the fines could not fall through even several times larger apertures of the cover, due to the quick movement.

In plansifters of recent design the forming of layers of grist is ensured from the beginning the part which has a higher specific weight occupies the area immediately on the sur-

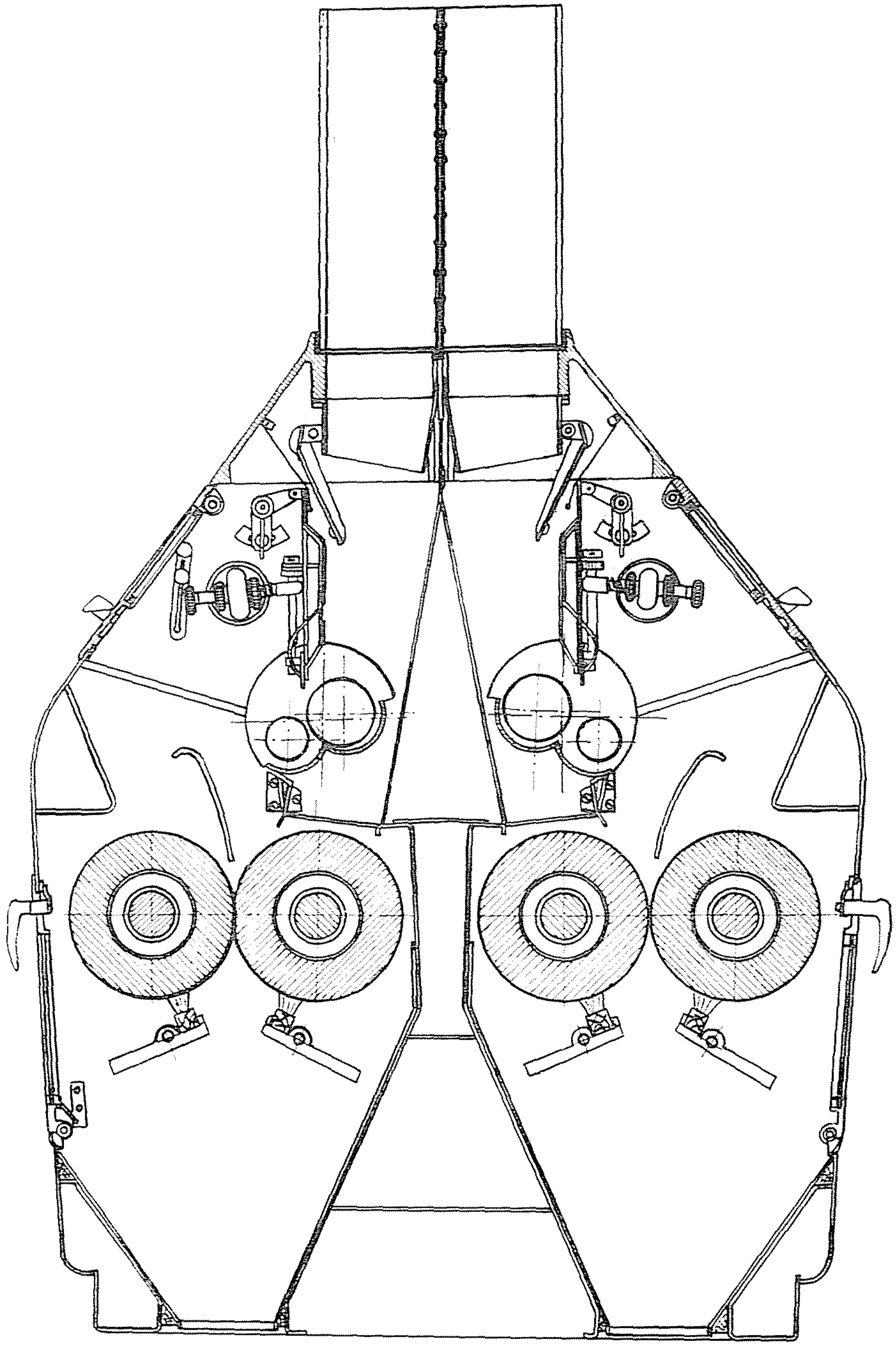


Fig. 2

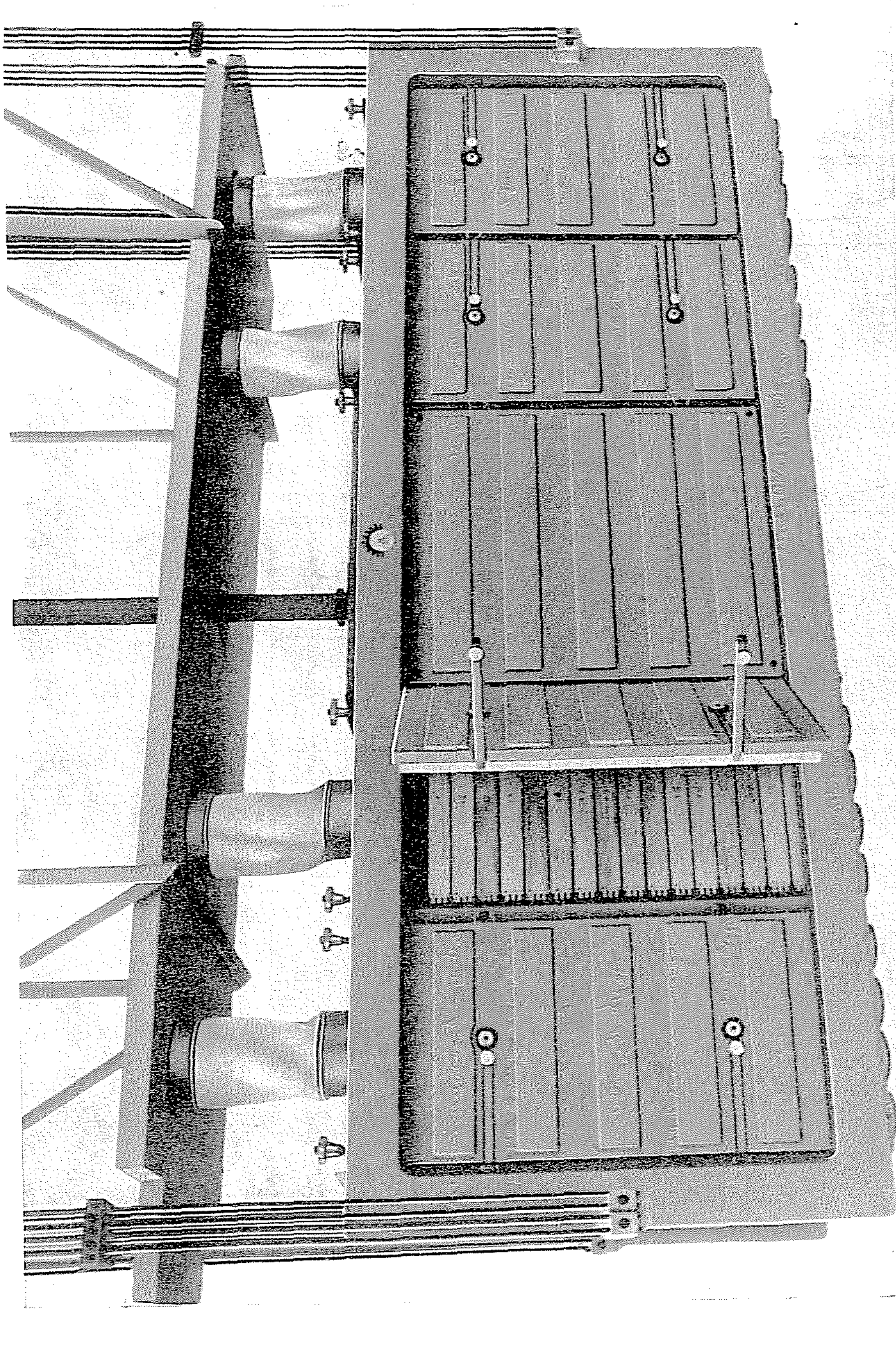


Fig. 3

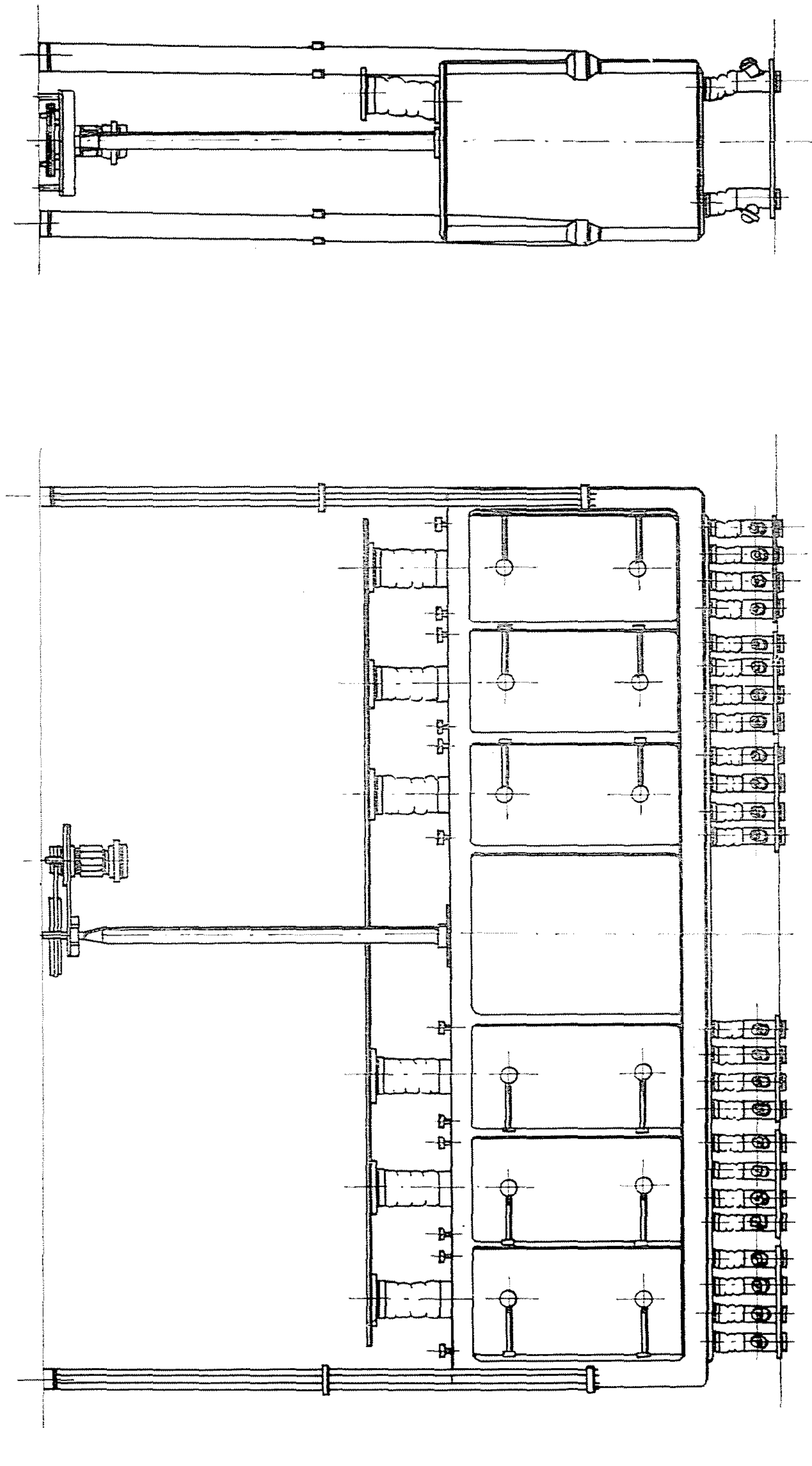


Fig. 4

face of the cover, while parts of lower specific weight take place on top of the layer; a witty feature in design enables them to move faster towards the outlet than parts having higher densities, which, indeed, strive to get themselves shaken into the apertures of the cover.

The design of recent plansifters allows to use two machines together as twin-sifters with 2, 4 and 6 sections, but when serving mills of lower output, sections 1—1 can be separated horizontally, too; thus two different sorts of grist can be introduced into each section, consequently 8 different sorts of grist can be treated in sifters of 4 sections, or 12 sorts in sifters of 6 sections, respectively. This is an additional advantage of the new design.

The plansifters are in motion or brought to stop smoothly without any shaking.

The machine is provided with a net sifting surface of 9—48 square metres to sift 2—12 sorts of grist, their power demand amounts to 0.4—1.5 kW.

The next machine of primary importance in the mill is the purifier.

The new design of purifier has a completely closed streamlined metal casing of appealing appearance.

The new machine has two sifting tables, i.e., the semolina is placed on two superimposed sieves. This feature results in a 40—45% increase of the output of the machine when covers are selected properly. It is a known fact that purifiers can operate efficiently only if the thickness of semolina layer is uniform all over the surface of sieves. This requirement is fulfilled by the possibility of adjusting the table of the machine at will, but in contrast to other similar designs, provision has been made to avoid even the chance of setting the table in an oblique or tilted position, since the angles of the rods of the table can be changed, and their height can be adjusted only parallel. Moreover, the semolina throughput can be removed from any sieve, and conveyed away separately. The grading of semolina being promoted by the shaking effect of the sieve can be controlled to a certain degree by adjusting the transmission, and by this means the possibility is given to promote the process of purification even through the shaking movement of the sieve. For this purpose, the design ensures easy adjustment and control of the sieves.

As it is known, during the purification of semolina a current of air effects the separation according to specific weights: light

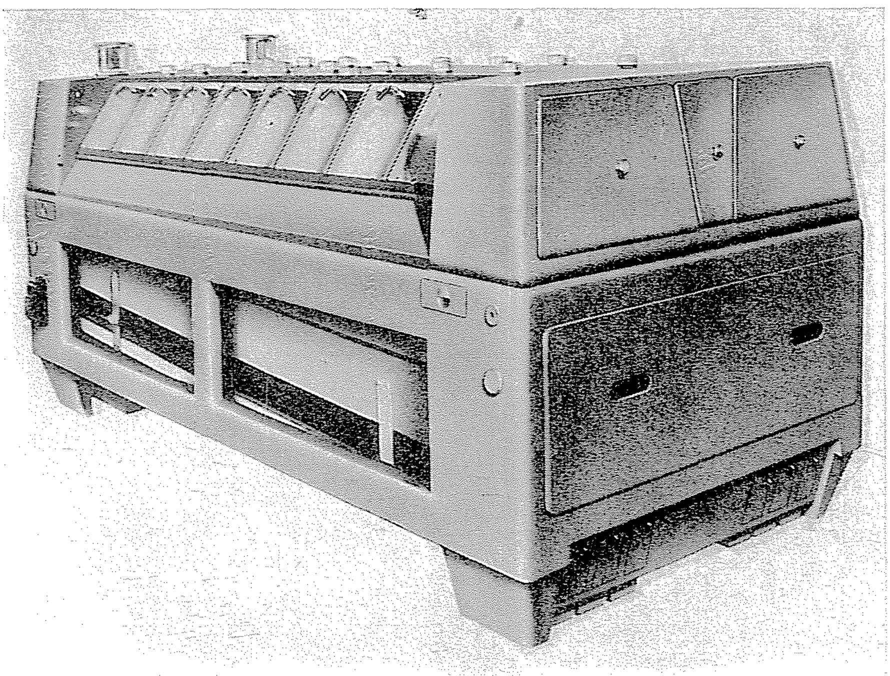


Fig. 5

particles are removed by this current from the material to be purified which moves to and fro on the sieve, and they are deposited either in a channel placed above the sieve, or being entrained by the air current are carried as far as the dust collector.

sensibly to fluctuations in quantity of semolina stock, and it regulates the thickness of semolina layers accordingly. The main collecting air channel has such dimensions which prevents settlement of the dust.

The design of the framework of the purifier

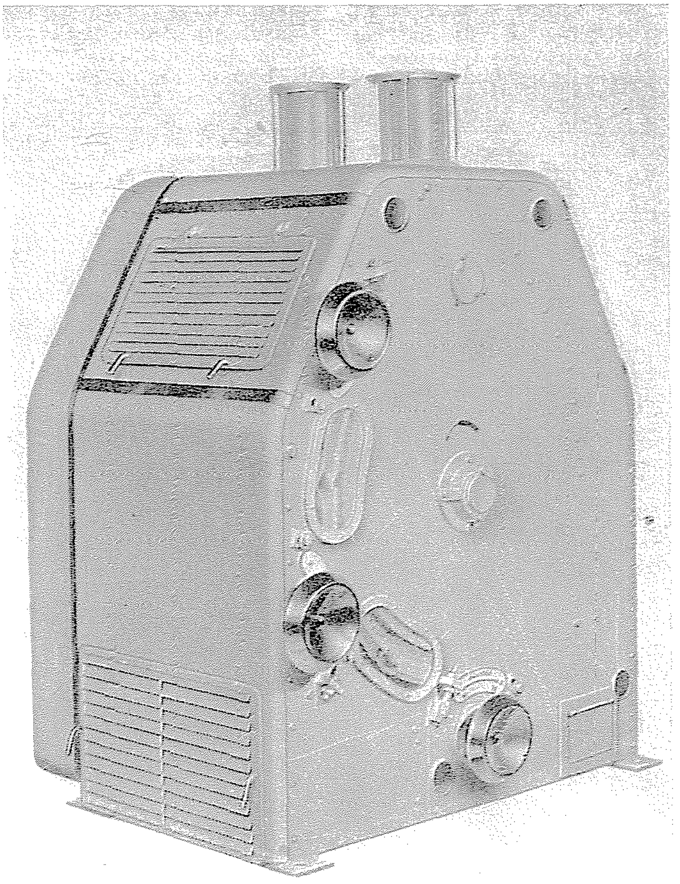


Fig. 6

To make purification more efficient the air channels are divided in eight sections instead of four of the earlier type: in each selecting section the velocity of air current can be regulated separately. In this way each sieve can work with two air velocities and the effect of purification will be better. The effectiveness of purification is improved by a brush mechanism of high operational safety cleaning the cover without any forced trajectory motion or hang. To feed the purifier with layers of uniform thickness it is fitted with a simple feed mechanism reacting

allows to superimpose two machines, and it means that double actual sifting surface is obtained on the floor space of one machine. This is significant because the building requirement is reduced, and savings in horizontal conveyors are possible.

When two machines are superimposed the design of the purifiers allows to convey transient pipes, turning over, and through the lower machine without the danger of mixing. In spite of this, easy access and checking is possible to control the material produced by the machine. The removal of sieves is done on the side of feed. Characteristical technical parameters of the purifier are the following:

Width of frame	Weight of machine	Rate of power input
250 mm	580 kg	0.5 kW
400 mm	650 kg	0.6 kW
500 mm	750 kg	0.8 kW

During the development of grinding grist-finishers have had an important role. The earlier method of grinding technology consisted in breaking the grain step by step to smaller pieces by rolls, and after this process first semolina, then middlings and finally flour were separated by sifting. During the process of repeated breaks also the cover of grain was broken in pieces in an undesirable manner, and the fine cover particles could be separated only with difficulty from the particles of flour having the same size. By applying finishers in the grinding process, the whole reduction system changed basically, for now covered material is not broken between rolls to fine particles, but the flour adhering to the cover is dusted out by the so-called "grist finisher". The beating of grist is done by a paddle machinery turning with high speed inside the casing provided with a mantle of perforated plates through which fine particles of flour fall out by the effect of beating, while covered particles leave — without being broken — on upper part of the machine. Fig. 6 shows a "grist-finisher" of this type.

The operation of earlier grist finisher of similar design was characterized by the impossibility of regulation. This deficiency is eliminated in the finisher of recent design, for it can be regulated at will during process. On the other hand, the degree of sifting can be altered by changing the perforated plates Regulation can be made in various ways: if the machine is not running, the perforated plates can be exchanged against others which are suitable to separate the required particle-sizes; the opening between the rotor and casing can be changed too, and finally the speed of conveying of grist in the rotor can be regulated even when the machine is running. Great importance is attached to this regulability, because more intensive processing is possible with a humid grist or with materials having tough skin, but light treatment can be given if it should be preferred for some reason.

Figure 7 shows that the inlet of the machine is set on the lower part, and the covered part in the rotor is lifted upwards, until it leaves through an outlet placed at the upper part, while the flour falls through the perforated mantle and goes out through the funnel-like outlet at the bottom of the machine. The small requirement of floor space is seen from Fig. 7 in so far that the little electromotor mounted on the upper part of the machine represents the whole floor space necessary for the machine. In the course of investigations which have been carried out so far, it could be ascertained that for example, if the machine is coupled after the 4th break system and only transients are processed, the colour and quality of the obtained semolina and flour is better than those of flour and middlings got from the break by the roll which is standing before. Undoubtedly, this new finisher will be a very useful tool in improving the work of break systems, and introducing more and better flour.

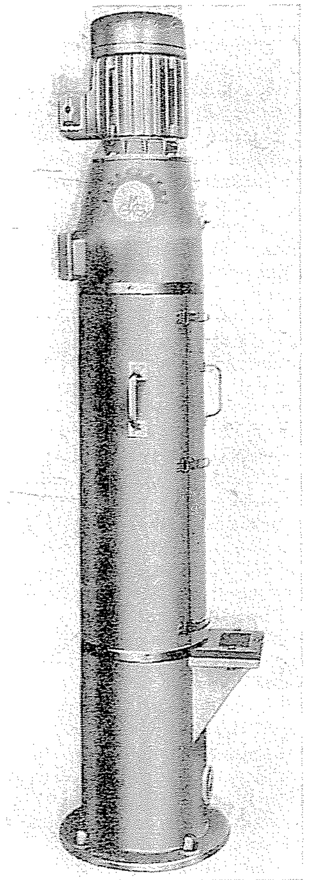


Fig. 7

The machine is available in two sizes with outputs of 450 kg p.h. and of 700 kg p.h., respectively.

The Hungarian milling machinery production has made a considerable progress in development of machines for wheat cleaning. Investigating the problem we can state that to improve modern milling processes and to produce flour with minimal ash-content a totally clean wheat is required. If dust adhering to surface of grain and to beard is not entirely removed in cleaning process, it comes whilst breaking in the flour and increases its ash-content. By the old cleaning machines an ideal cleaning could not be reached, since it was not possible to regulate the working of machine and vigorous working had harmful effects in so far as many grains were broken decreasing the useful content of grain, moreover, the breaking surface — being similar to blotting paper has taken up various impurities increasing the ash-content while milling.

These disadvantages are eliminated by the recent design of grain brush machine (Fig. 7) allowing a regulation — while running — in three parts of the cleaning surface, as cleaning requires. Characteristical disadvantage of the old brush machines has been that the cleaning brushes were weared out in a relatively short time, and the cleaning work decreased in accordance with it, rapidly. Brushes have been in practice not often readjusted, since this operation needed usually the dismantling of machine, whereas the design of recent brushing machines allows to do this as required by the degree of cleaning, thus cleaning work can be regulated.

A large number of comparative tests have ben made in order to control the cleaning effects of old and recent machines and it could be stated that while by recent machines the beard can be removed up to 90% without violating the grain, but this can be done by old machines only up to 10—15%.

It is a well known fact that the beard is a bearer of various microorganisms and of fine abrasive dust. It is obvious that quantity of fine abrasive dust adhering to the surface of grain will be decreased by removal of beard. It is proved by comparative tests of these machines (old type and recent type) in the same mill that if an old machine was used the ash-content of the first break's flour was 1.2—1.4% but if recent machine was employed it decreased — beside unchanged conveying of first break — to 0.6—0.65%, and this gives the proof of efficiency of the cleaning effect of machine.

The brushing machine of recent design contains a brushing roll carrying completely closed plastic bristles connected to three separated regulable segments which can be provided with covers at will and can be adjusted while running in a simple way, as required by cleaning. The machine is supplied with a strong aspiration to carry away the fine dust separating from the surface of grain, and to press it into dust-collector. The machine is characterized by small space requirement and high performance, and its power demand is the half of that of the old machines; simultaneously it can be stated that in the case of correct adjustment and handling, the breaking of grain is minimal in comparison with the old machines. Miller's old saying: "good scouring is half milling" has never been so true than in the case of this new brush machine of which efficient working enables mills to produce flours with minimal ash-contents for it removes all dirt actually sticking to the surface of the wheat without injuring the surface of the grains.

The machines are characterized by following parameters:

Output per hour	Space requirement	Weight
2500 kg	1,5 squ. m.	320 kg
3500 kg	1,7 squ. m.	450 kg
4500 kg	1,9 squ. m.	730 kg
5500 kg	2,2 squ. m.	900 kg

We have described above five various machines of recent design for the milling industry differing fundamentally from the old ones, and in quality and quantity of working they surpass all known types. Moreover they meet the requirements of modern technology by giving a high output of first quality of flour with low ash-content.

These five machines represent but a small part of the work done in the development of the Hungarian milling machinery production.

ELECTRICAL RELATIONS OF ELECTROSTATIC SEPARATORS

by

L. Raschovszky

The electrostatic separators are gaining more and more importance in the industry as well as in the dust extracting plants for hygienic purposes.

Owing to its own causes, development in general use was slow. Equipments of safe operation were manufactured in the 1920's, yet 40 years were needed for application on a large scale.

The separator itself has a simple construction but its running requires high technical knowledge in various fields of science. On investigating these technical phenomena, various electrical relations can be observed.

Figure 1 shows a separator of horizontal design.

Figure 2 shows a similar equipment during construction designed and executed in Hungary.

Investigating the sequence of working process and leaving out of consideration the importance of electrical relations, the most important object is to ensure the uniform gas circulation in the separator.

A compensating grid serves to meet this demand, with a dual purpose. The first one is the ensuring of the circulation of gas, the second one the removing of dust particles charging the gas. As the dust content charging the gas is the highest on the inlet side and as 10—20 per cent of this load is separated by the compensation grid, its importance is evident, showing at the same time that the inlet point is a delicate part of the separator. That is why it should be protected against blocking up, by shaking and knocking of the grid, moreover for this end soot blowing equipment should be provided too.

Besides ensuring the uniform gas flow in the separator, various other conditions are required in order to reach adequate separating efficiency. The efficiency is influenced by the chemical composition of material (dust), the sizes, the quantity and the temperature of dust particles, further by the magnitude of originating electrical field, and by the number of simultaneously liberating electrons expressed in mA. It is apparent that in this process physical, chemical and mainly electrical effects are cooperating. Lots of observations and investigations are required to ensure the highest rate of efficiency. If the physical and chemical properties are previously determined for a given equipment, — these must be regarded as constants, and electrical characteristics have to be created for them. For this reason, the electrical equipment creating actually the electrostatic field is the denominator of equipment.

Figure 3 shows the schematic circuit diagram of this equipment, where field strength is created by the tension (e) between the positive and negative poles. Its function is given by the size of equipment and the properties of circulating gas, since it is limited by puncture causing short-circuit and potential breakdown. The other responsible value is the magnitude of charge (Q) ensured by the corona-phenomenon. The power (F) carrying the dust particle to the electrode on the receiver, can be expressed by the product of these two electrical phenomena. Thus:

$$F = Q \cdot e$$

For bigger equipments a potential of 40—70 000 V and a current of 200—1000 mA must be ensured. In the schematic current diagram of Fig. 4 the apparatuses of the main electrical equipment can be traced.

A regulator transformer with a ratio of 1 : 1 is connected to the network, followed by the high-voltage transformer and the rectifier.

These transformers are of simple-phase or three-phase transformers having so to say the same construction all over the world: there are no technical problems. Yet the rectifier has more importance.

At present the mechanical (rotating) rectifier is the most popular for this purpose.

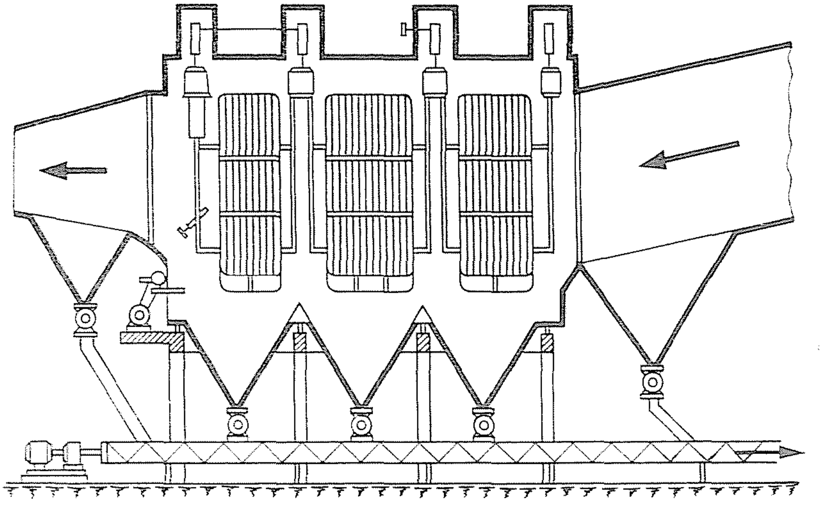


Fig. 1

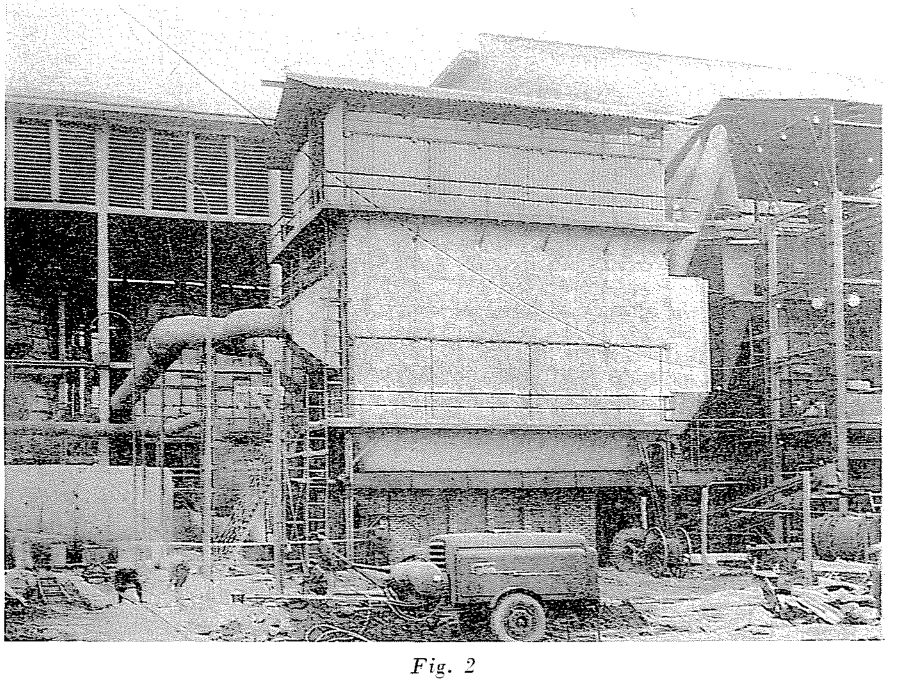


Fig. 2

Figure 5 shows an equipment of Hungarian make. They are reliable in service, but have some disadvantages, such as: they cannot be parallel connected, the doffers are to be changed systematically in working, the rotating elements require lubricating and treatment, and moreover, poisonous gases arise from sparking over the contact clearance.

All these faults are eliminated by the selenium cell (semi-conductor) system completed with the advantage that the output of the unit can be twice or trice higher than that of the technical system.

The automatic-device effects also the economical working of the electrofilter, as it not only provides the rectifier with the most favourable working conditions, but it also keeps the highest voltage to be reached beside ensuring the safety of operation and the highest emission current.

Though the flowing and electrical phenomena, listed so far — or rather the equipments which created them — have performed the main operation consisting of dust-separation on the receiving electrode, the discharge of the dust remains to be solved.

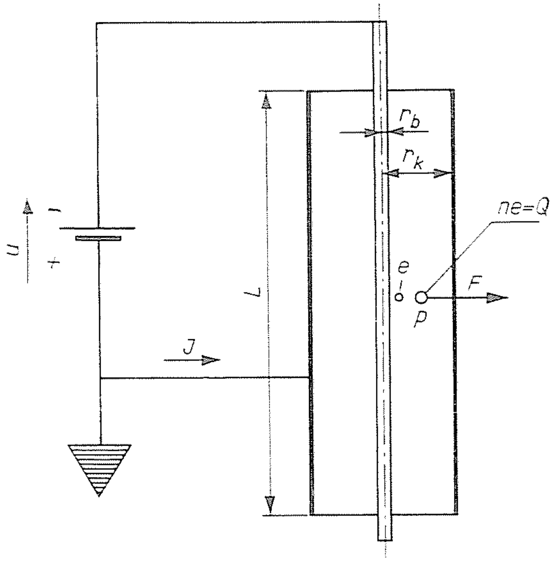


Fig. 3

Figure 6 shows a selenium rectifier of Hungarian make and Fig. 7 presents a control-instrument board belonging to the rectifier. The output of the equipment is 500 mA, but the design of equipment for higher output is well under way.

The single problem of the selenium rectifier is the warming of the plates. A relatively low temperature is required (about 70° C), otherwise crystals disintegrate, and the rectifying property of semi-conductor will cease and the metal of low melting point (Wood's alloy) being the current collector and the protection of the crystal structure may melt.

Punctures occurring, so to say regularly, in the separator lead to the overloading and overheating of the selenium plates. That is why the equipment is delivered with automatic-voltage regulator selecting the highest voltage to be kept continuously, by the lowest number of punctures.

The dust particles settling on the electrode of the receiver come into contact with the plates and themselves respectively by cohesion, a dust layer appears on the plates after a certain time. Should the plates be submitted to shaking in due time, the layers sticking together, will loosen and due to their own weight fall into the bunkers excluded from the flow of gas. From here dust is easily discharged and transported with various conveyors.

This process seems to be very simple, however if the receiver plate is too often or constantly shaken, the forming of the layer would be hindered, resulting in the dust particles remaining in their original form and not sticking together, and returning thus in the gas-circulation. The suspended dust particles would leave the electrofilter with the gas. In this case the efficiency of separation would be low. But if shaking is done

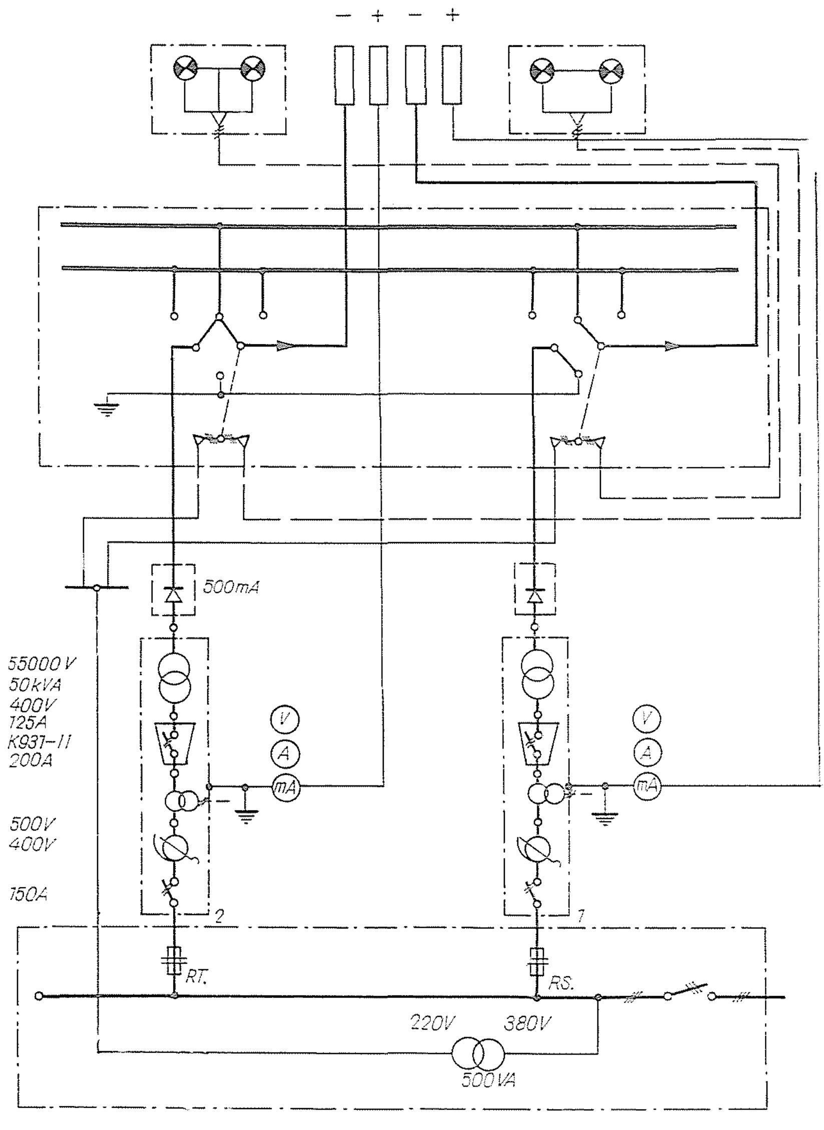

– + – +
500mA
55000 V
50 kVA
400V
125A
K931–11
200A
500V
400V
150A
V
A
mA
2
1
RT.
RS.
220V
380V
500 VA

Fig. 4

rarely, an other disadvantage arises as the dust particles sticking to the inner side of settled layer are usually in contact with dust particles having good insulating properties, hindering the loosening of their charge, and leading the weakening of the electrical field of the separator. In order to increase the efficiency of separation, shaking should be intermittent. With different timing for each cell in sequence of the direction of the gas flow the forming of the layer being most favourable for shaking requires more and more time with the decreasing dust load. The electrostatic-separators can be provided with the automatic control apparatus accommodated in the control board figuring in Fig. 8 to be adjusted to the required program. An electronic-impulse-transmitter equipment is set — according to program in advance — to ensure the following operations:

1. Selecting the shaking sequence of each cell including the rectifying grid, mentioned in the description of the preliminary.

This is necessary, because the shaking of all the receiving electrodes at the same time is not advisable as this process would increase the rate of dust load to such an extent, as would lower the efficiency below the attainable level.

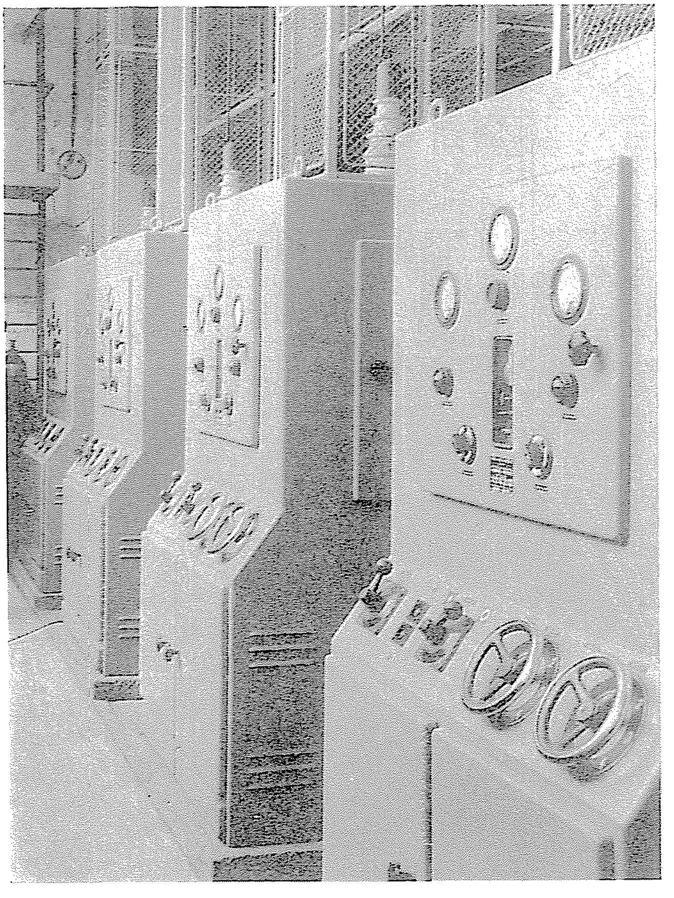


Fig. 5

2. Selecting the intervals between shakings.

According to causes described before, most frequent shaking is needed on the side of the rectifying grid, whereas the longest intervals are for the outlet side.

3. Adjusting of the most favourable shaking time.

Meaning the time between starting and stopping of the shaking apparatus. As experiences have shown for loosening the dust-material sticking to the plate, — according to the

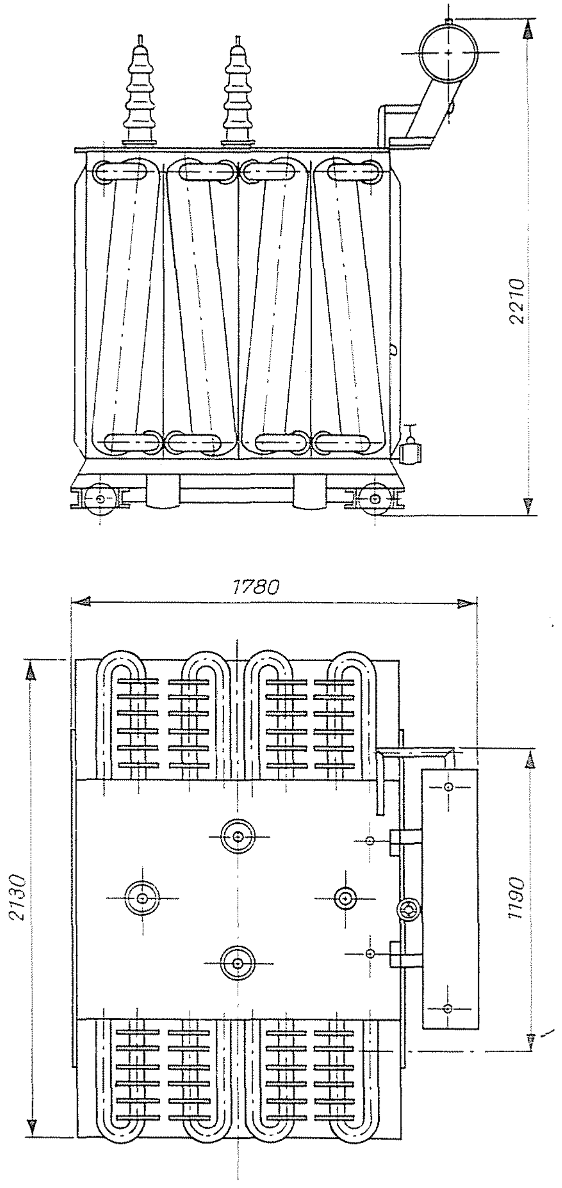


Fig. 6

conditions of working — different periods of shaking are needed. It is obvious that this equipment is by its unlimited possibility of adjustment suitable to meet the very different working conditions of various plants.

Opposite to the formerly used hammer-shaking system, the recently applied vibrat-

In this case, the separator system which is illustrated in Figs 10 and 11 is better, though its costs are higher. The shaking of this system is performed everywhere in a manner by which the frame is raised on a point with some centimeters and when it drops down, the stroke results in a shaking effect.

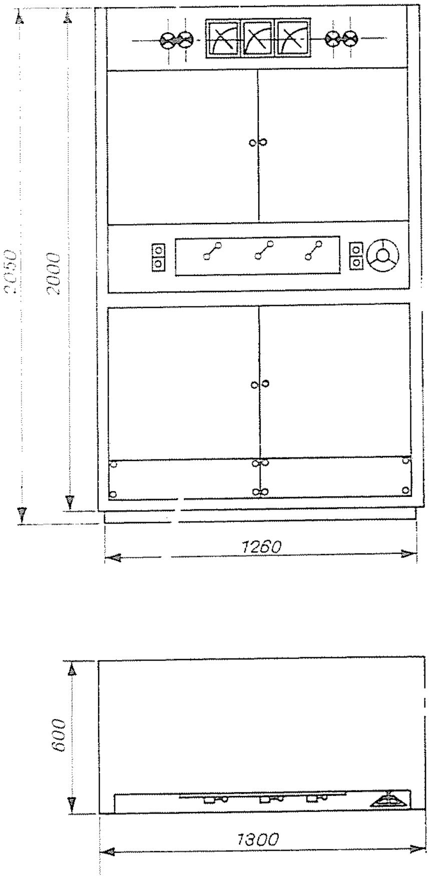


Fig. 7

ing-shaking system gives better results. Its action is more intensive, the control is more simple, and it ensures more variations.

The problem to discharge the dust becomes harder in separators of vertical gas-flow. The simple plated receiver electrodes cannot be employed here, since the dust-clods shaken down from the grid, and falling in opposite direction of the flowing gas are more inclined to disintegrate and to return in the gas-flow as dust particles increasing the dust load of the gas. This phenomenon leads to the decreasing of efficiency, and to eliminate it, the dimensions of separator must be altered.

And finally it is necessary to shake tne sprinkling electrode too, because the dust which settles on the electrodes increases the danger of puncture if the dust appears in clods or if an even layer is created, it increases the diameter of sprinkling electrode, and by this means decreases the corona-phenomenon. The dropping disc (illustrated on Fig. 12) lifts a hammer system or drops it to the frame holding the sprinkling electrode, ensuring so the necessary shaking effect. The changing of shaking periods is not required here and for this reason the intervals between shakings are adjusted by the continuous rotation of disc.

The high-voltage bushings are essential and in respect of electricity very delicate parts of the equipment. Most faults (break of quartz-tubes and insulation) take their origin from the great difference of temperature between the inner and outer space which is usually stray currents cause punctures. The high heating effect, developed suddenly due to puncture on a small spot, may also lead to the fracture of quartz-tube. The puncture itself means also a disturbance in the service because so the bushing becomes the delicate

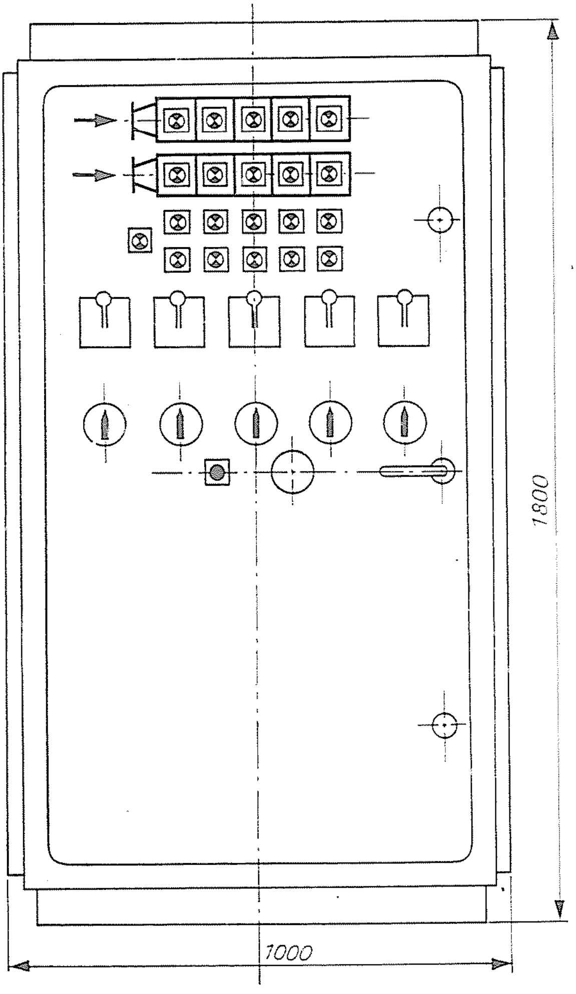


Fig. 8

over 100° C. Should the inner temperature rise suddenly to the service temperature, the quartz-tube cracks because of the inner tension, and puncture along the gap is unavoidable. Other working fault arises by the fact that from the warm gas a condensate is precipitating on the cooler surface of quartz-tube welling or contaminating same, thus part of the equipment. To eliminate this trouble electric-heating is used in the inner space of the bushings ensuring the required ambiant temperature before the beginning of the operation. As it was told before, the working conditions of the electrostatic-separator are very delicate and the costs of its investment are high. Now the question arises:

what is the reason of its widespread use. The question may be answered without penetrating in economical calculations.

The electrostatic-separators can work faultlessly up to 5μ - 0.5 μ sizes with a good efficiency (99.9%). Whereas the known mechanical separators work under sizes of 5 μ only by — to achieve an efficiency of 99%. Economical calculations are to be made only in rare cases when both systems may be taken into consideration.

For separation of sizes between 5μ–1 μ, the sack-dust-filters will fulfil the requirements. They are used in some places, but the

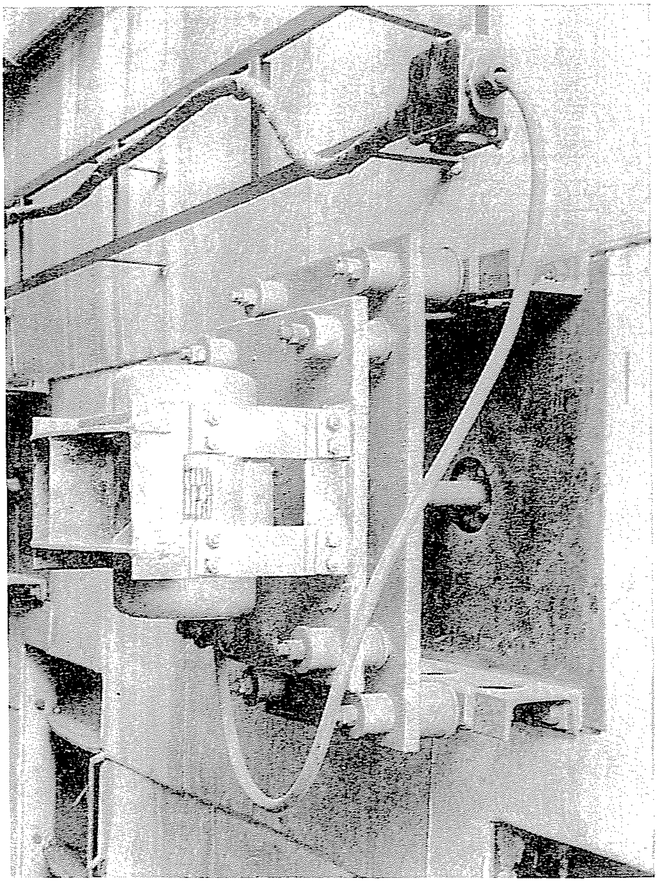


Fig. 9

high power requirements and they achieve only an efficiency of 80–90%. And at the same time, there are industrial gases to be cleaned in a scale of 10,000 or 100,000 Nm^3. The multi-cyclone gas-purification of about 85% efficiency in a medium power plant requires an energy of 200 kW. The same work can be performed by the use of electrical gas-purifier with an efficiency of 99% and by the energy-consumption of 15 kW. It is clear that in this case economical calculations have no competence. If the gas contains mostly dust particles of 2μ–0.5 μ sizes it is not possible — by using whatever large cyclone temperature of gas is limited because of the textile-material of the sacks. On the other hand, the temperature of industrial gases to be cleaned is generally over 100° C. (Rotary furnaces, clay-driers, stone-driers, sulfuric acid works, metallurgy, etc.)

As final result we can say, that general use of electrostatic-separators is determined by the following factors:

1. Social requirement for stopping contamination of gases polluting the air.
2. This can be done only with the electrostatic-dust-separators.
3. Low power-consumption.

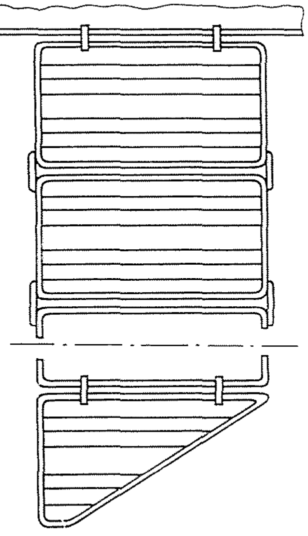


Fig. 10

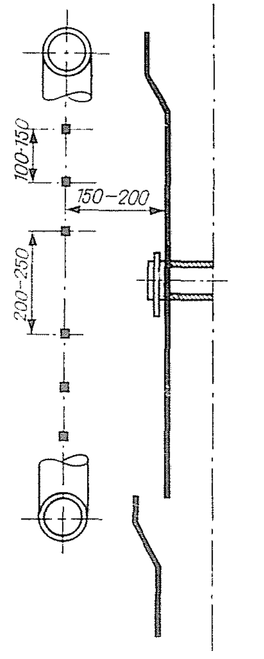


Fig. 11

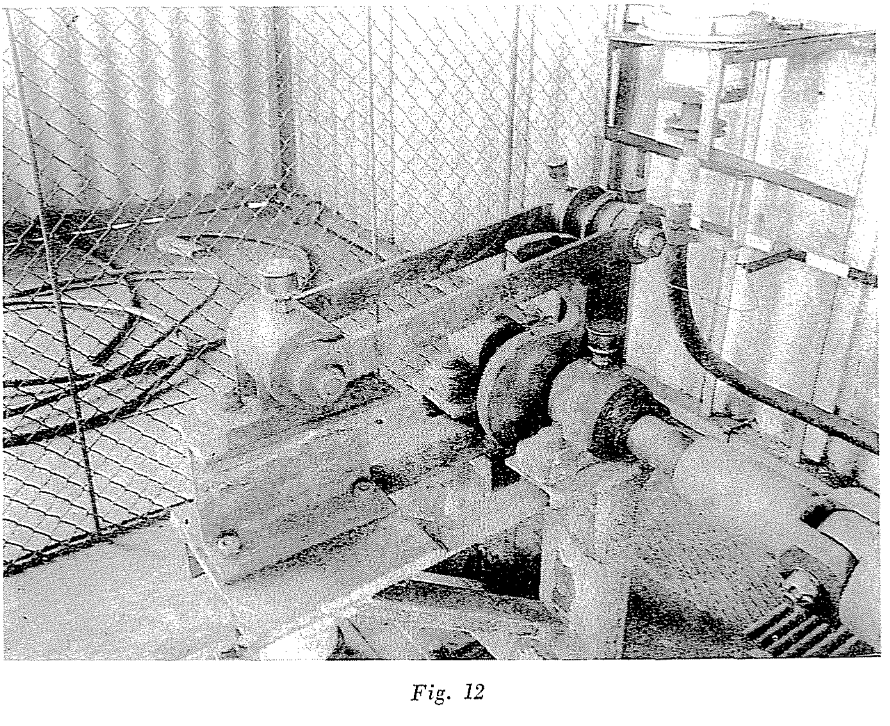


Fig. 12

DESIGN OF BOILERS OF MEDIUM CAPACITY SUITABLE FOR FIRING COAL OF HIGH CALORIFIC VALUE AND DUST CONTENT

by

F. PETRASICS

In the last years the Hungarian Boiler Works have produced several boilers of medium capacity for firing coal of high calorific value and high dust content. The whole equipment — including 3 boilers of 120 t/h capacity — has been exported by KOMPLEX for the power plant of Wang Ting in the People's Republic of China. These 3 boilers were designed to fire coal of 5260 cal./kg heating value. The fuel has a volatile content of 40% related to the dry coal. This volatile content made possible to carry out the economical solution of granulating firing of pulverized coal. The boilers are provided with 3 KSG coal grinding mills ensuring proper firing efficiency if grinding fineness is $R = 15\%$. Warranted measurings have shown — to customer's content — 89 – 91% net efficiency.

The power plant was put into operation, and somewhat later, KOMPLEX or the Hungarian Boiler Works received a new order to produce one further boiler of 120 t/h for enlarging the plant. The primarily used coal came from the production of surrounding mines, but the enlarged plant demanded to open new coal sites. But the coal raised from these mines has considerably lower volatile content. One coal type has 16.4%, but the other only 7.1% volatile content; the heating capacity is on the average 6200 cal./kg. If coal is used of such a low volatile content the proper firing efficiency and stable firing can not be ensured in an economical way by granulating firing, and for this reason a new firing method had to be used in the enlarged plant.

The new boiler is similar to the former type with natural circulation and capacity of 120 t/h. Yet its combustion chamber is shaped suitably to the KGS vertical firing — on the basis of KGS licence. The combustion chamber takes on the shape of a cylindrical cyclone of vertical axis and has at the transition which leads to the upper combustion chamber a circular tubular grid suppressed necklike. The cyclone consists of tubes set closely side by side, and has a plate shell welded from outside directly on the tubes. Ring shaped profile steel bandages fasten the plate shell, and the whole tubular unit is hung up on the base of boiler. The cyclone becomes downwards closer, gets funnel shaped, and has in the centre a small circular outlet.

To decrease the cooling effect of tubular system the tubes are covered with a heat resistant composition on the side facing the combustion chamber. The composition is held by mandrels welded closely, side by side on the tubes. The loading of combustion chamber is about $1.0 \cdot 10^6$ cal./m^3/h, and as a consequence of the high temperature of combustion chamber the coal cinder melts. Owing to tangential blasting the melted cinder sticks to the wall of cyclone. At the high temperature of combustion chamber, each coal, even the coal of poor volatile content catches lightly fire, and the stability of firing can be held. Good firing efficiency does not require higher fineness in grinding, contrary to granulating firing, where the requirements are more stern; and by this means, the consumption of grinding power, thus the self-consumption of equipment, decreases. Owing to the centrifugal effect of tangential blasting the coal dust particles stick to the wall of cyclone wetted with cinder. As an effect of the relatively large difference of velocity between the adhered coal dust particle and air, burning progresses and is promptly completed.

The production of a complete cyclone requires peculiar precision in bending and mounting of tubes. The production and mounting of cyclone and mounting up mandrels on tubes is performed by means of modern technology, employing models. The completely mounted cyclone, measurements of which are controlled in the factory, will be taken to blocks, and transported to the site of installation. This method reduces time required for installation on the site, and better precision can be achieved.

In cyclone firing a broad scale of fuels can be employed, and firing remains economical if coals of higher volatile content are used. While keeping high efficiency — it is advantageous that problems of removing and placing fly ash can be solved very simply. This has special importance for populated districts near cities, where the question to place the fine fly ash originated from granulating firing of grinded coal must be solved, and contamination of environment should be avoided. In the cyclone 35—40% of cinder takes up a fluid state, yet if the fly ash is returned from below of fly ash separators to cyclone, the whole quantity of cinder can be obtained in melted form. The task of removal and placing of cinder agglomerated in the watery bed to coarse granules gives no troubles; impurities do not remain. The cinder granulate of cinder melting boilers is a very useful ingredient for the building industry.

In Vietnam we had to solve problems under the same conditions as in China, i.e. firing fuels of poor volatile content and high dust content in a power plant equipped with boilers of 25 t/h capacity. The coal is anthracite of 6200 cal./kg heating value, of 8.52 volatile content, 18% ash content, and 5% water content.

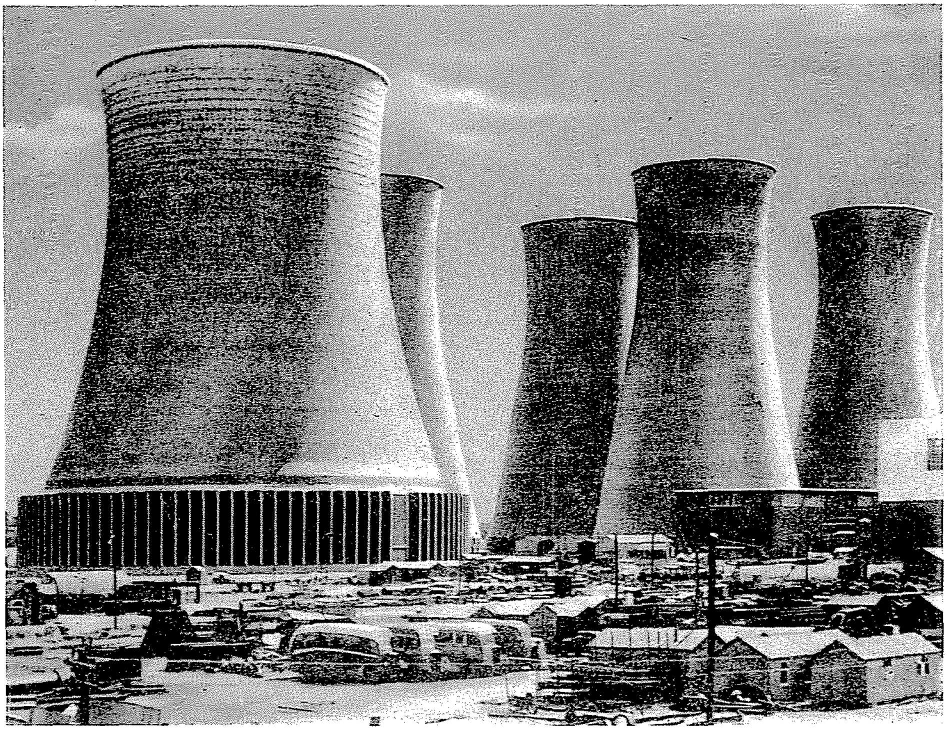
For technical reasons, cyclone firing cannot be employed in boilers of such small dimensions and so another solution had to be found to ensure a steady and economical firing. Anthracite catches fire favourably — in spite of its low volatile content — at high temperatures. The high melting point of coal cinder has given the possibility to fire at higher temperatures in the combustion chamber. But troubles have arisen by the high dust content of coal. The earlier BW boilers of 10 t/h capacity of Vietnam have long and low frontal vaults and are very suitable for firing nut coal, yet the capacity and efficiency of plant decreased when coals of high dust contents were fired. Granulating firing could not be employed in this case, since the possibility of applying a supporting flame failed.

Experiences have shown that pulverized anthracite catches easily fire by grate fire. On the other hand, the fire of pulverized coal has favourable effect on the burning of coal lying on the grate. Carrying out various firing experiments a combined grate—pulverized coal firing was evolved, and completed with a cinder-generator (set behind the travelling grate) in which the cinder fallen off the grate is secondary burned. The grate is rated to 80% of boiler capacity, and with pulverized coal firing 50—60% of boiler capacity can be attained. The overlapping dimensioning of grate firing and pulverized coal firing enables to set the rate of the two firing methods at will; thus, best conditions for favourable firing can be ensured. The layer of coal on the grate is thinner than usually rated, and it is a mixture of coal and 10% screened coarse cinder. The hazards of crater formation can be reduced by employing thinner layers, but stable firing bed cannot be formed. To ensure the stability of firing, a vertical pulverized coal firing chamber is set after the front vault. This smaller combustion chamber is separated from the main combustion chamber by a vertical tube grid, and the side of tube grid which faces the forehearth is covered with a heat resistant composition in the same manner as it is applied on cyclone boilers. The other sides of the forehearth have no cooling either, thus high temperatures and proper ignition can be achieved. The temperature of combustion chamber is controlled by adjusting the excess air. The vertical tubes direct the developed coal flame vigorously towards the grate, and by means of mutual effect of the two firing methods, as well as through right setting of the rate of coal dust firing and grate firing we can keep a firm hand on firing, and proper efficiency can be reached.

The main combustion chamber is open, and has no rear vault. Owing to low velocity of flue gas, only comparatively small quantities of flying ash are leaving. The fly ash is detached in the separator placed on the end of boiler, and can be fed back to the forehearth. The cinder generators placed behind the grates serve to burn out completely the cinder coming off the travelling grate. The glowing cinder staying for longer time in the cinder generator can be completely burned out by blowing in a little air.

By the aid of this combined firing method it is possible to fire anthracite of high dust content and low volatile content with good efficiency. The method is very simple, and the manipulation is easy too.

THE 120 MW DRY COOLING TOWER SYSTEM HELLER OF RUGELEY (U. K.)



is at present the largest of its kind in service in the whole world. The Air Condensation Plant was supplied to the Central Electricity Generating Board by The English Electric Company Ltd., under licence by, and in association with, our Company. The turbine (also supplied by The English Electric Company Ltd.) was first on load in December, 1961, full load was achieved in March, 1962.

While further, some of them even larger, units are currently designed on the base of the "Heller System", the Rugeley Plant as well as the first commercial installation of this kind, that in the Danube Steel Works in Hungary (commissioned in March, 1961) continue to give excellent service.

For further information please contact

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