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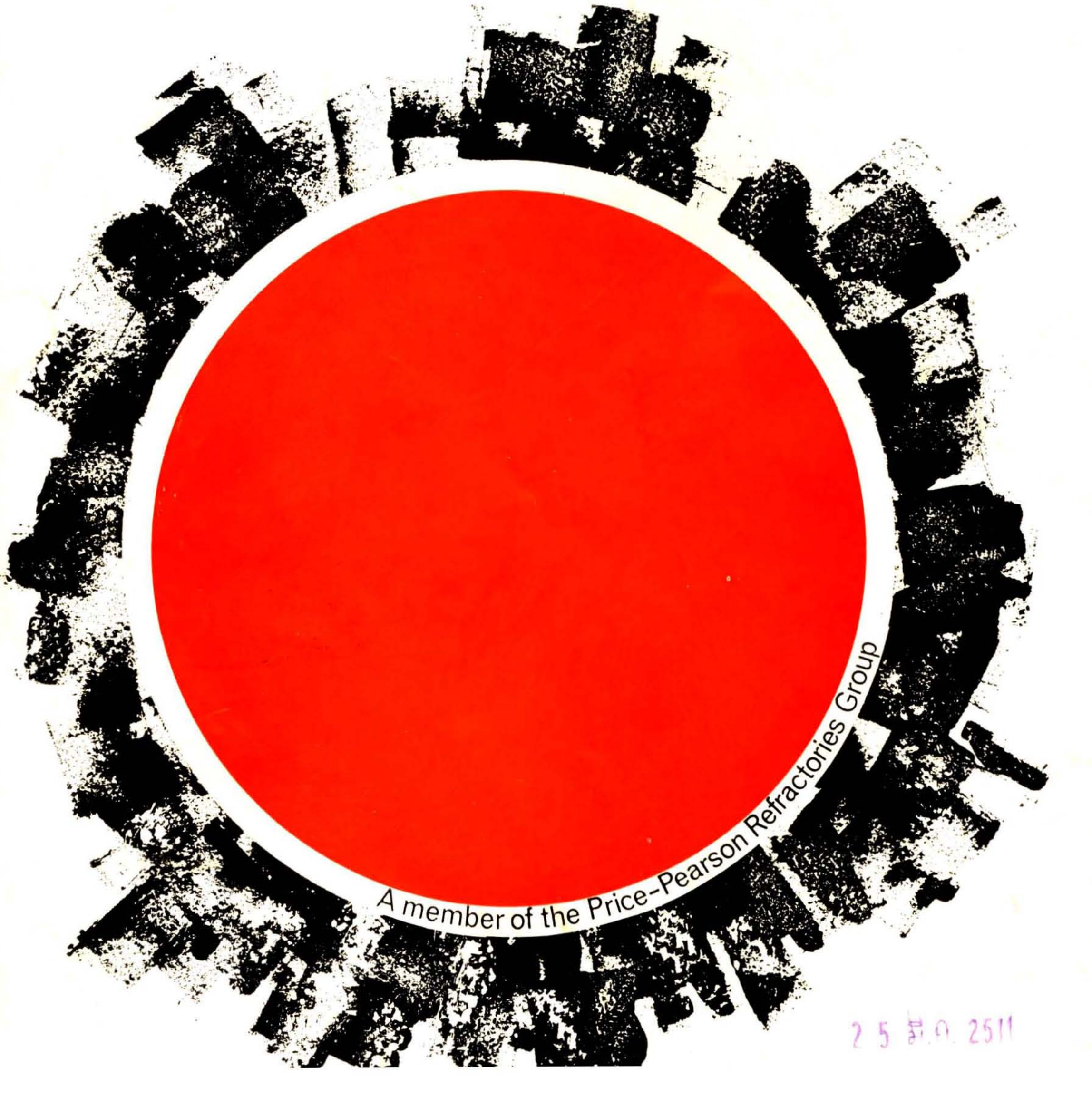

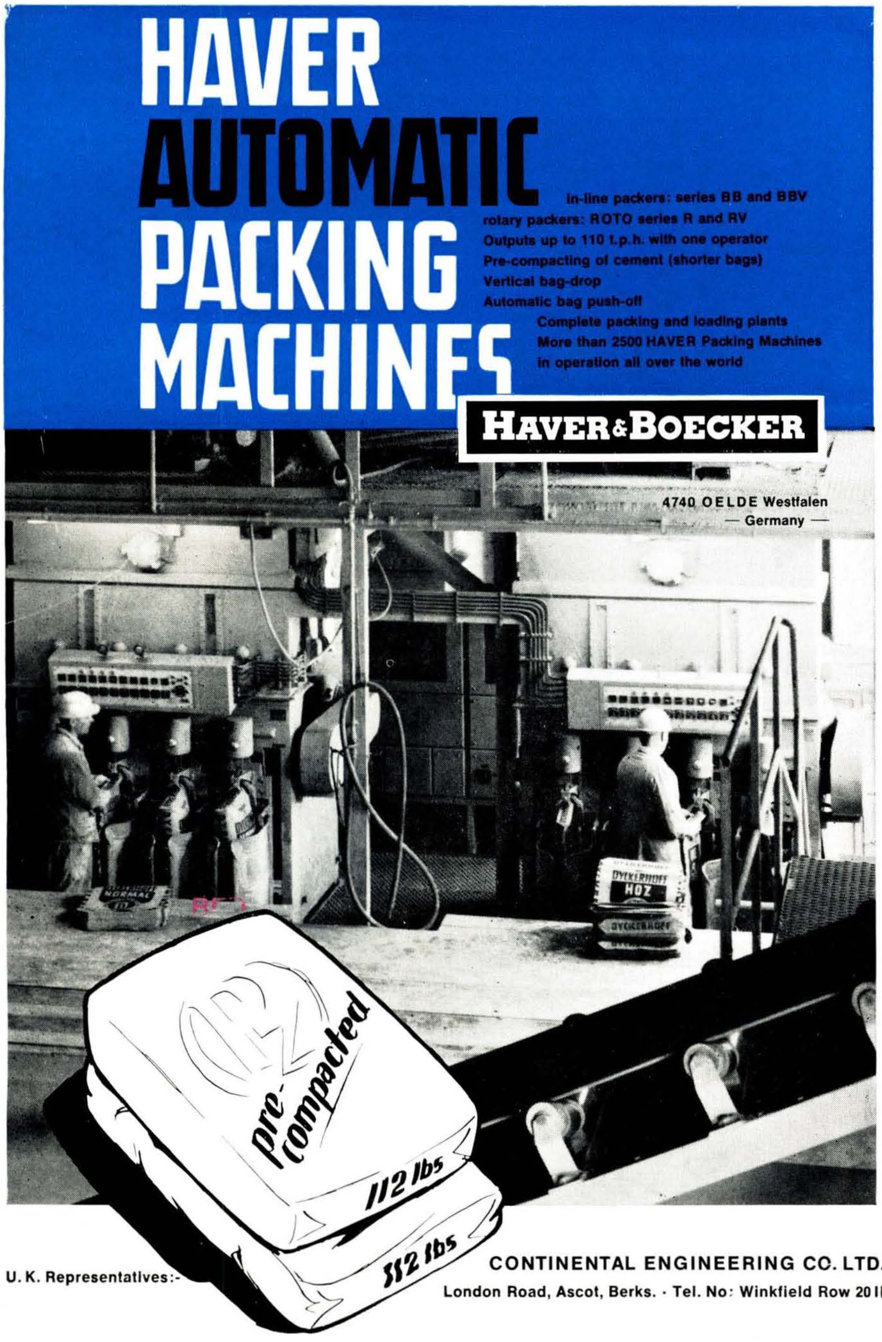
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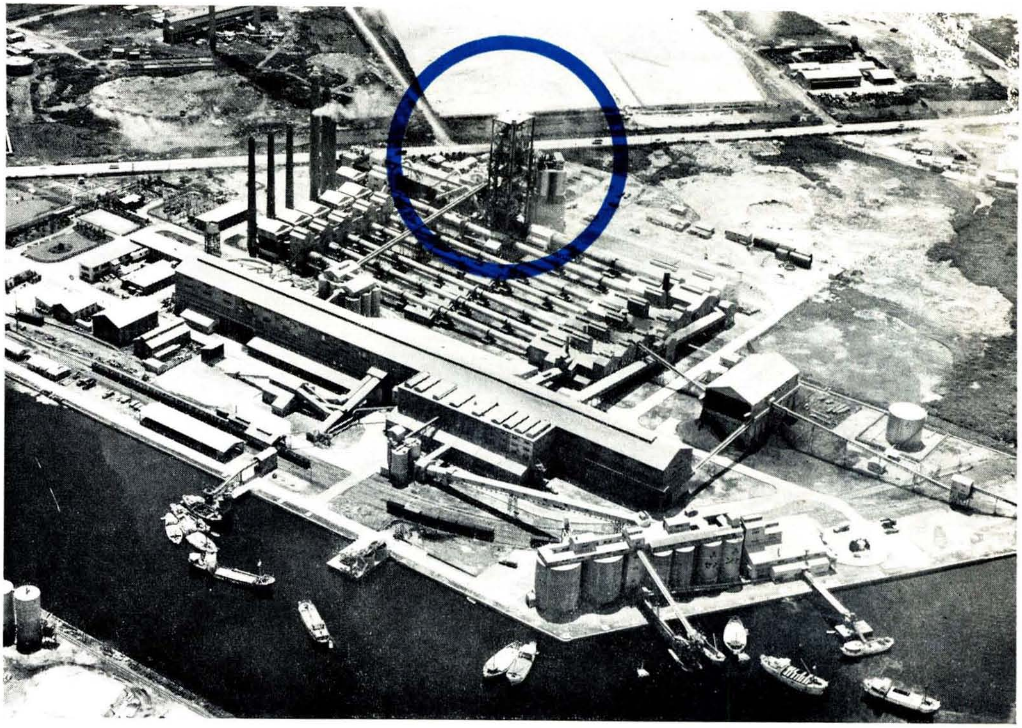

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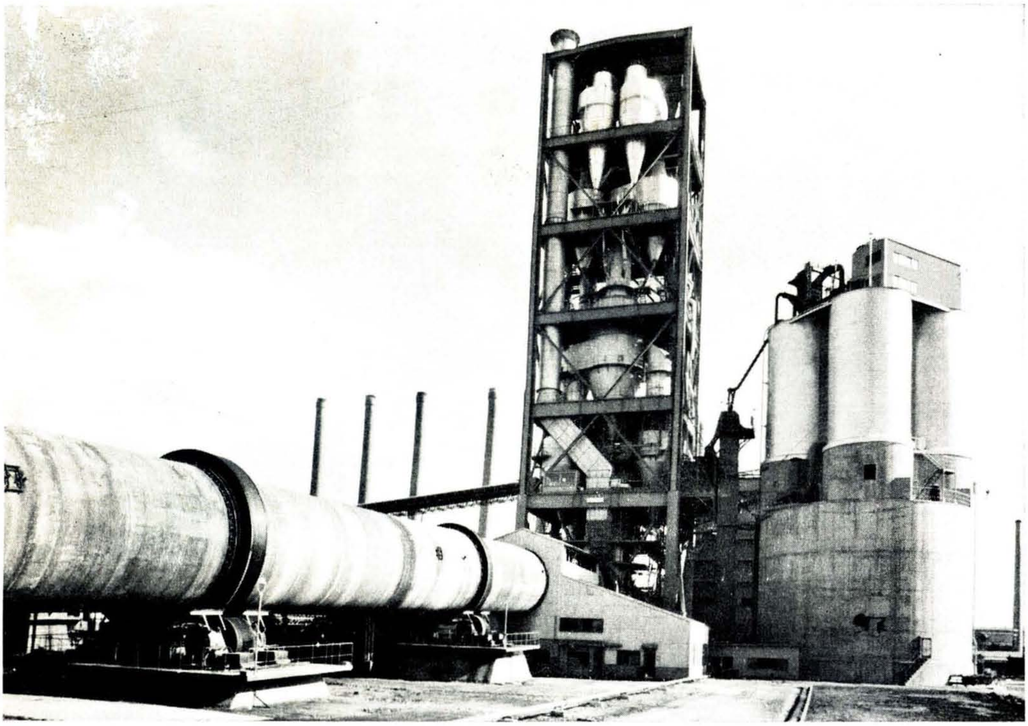

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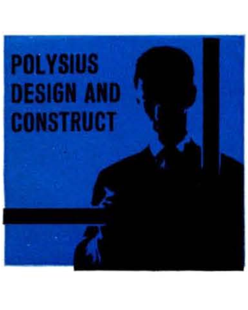

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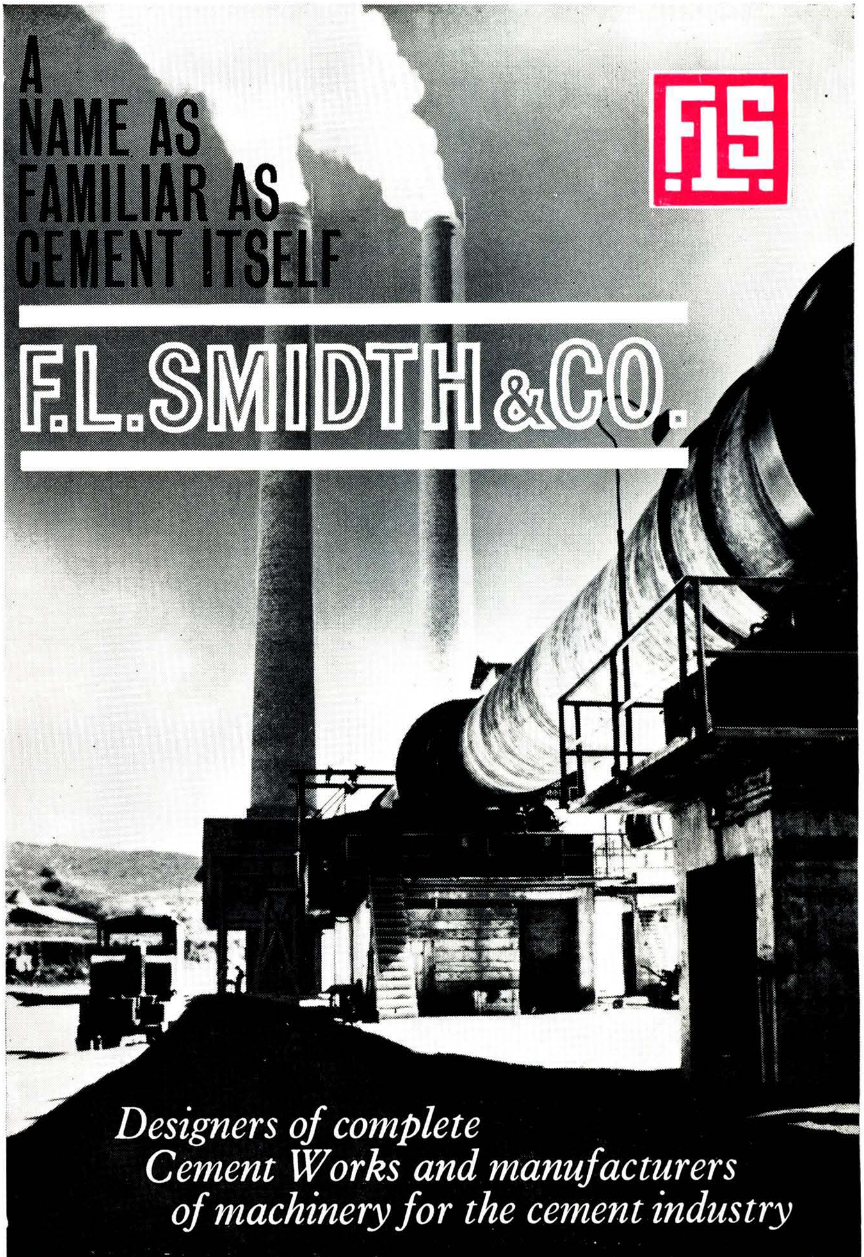
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Separating Effect and Efficiency of Cement Classifiers.

By DR. R. RUEGG*.

MACHINES generally called " classifiers," are required for closed-circuit cement mills for the purpose of separating the ground material coming from the mill into coarse and fine fractions. The classifiers are required to separate out a finished cement of specific fineness, for which the Blaine value is the usual standard. A good classifier should carry out the separation with the greatest possible selectivity. As little as possible of the fine material should pass back into the grinding process, since it would give rise to an undesirable process of agglomeration and to a cushion effect in the mill, and would lead to higher consumption of energy in the grinding process.

Fig. 1 (page 2) is a simplified diagram of a closed-circuit grinding mill with a classifier. The material for grinding flows through the mill and is conveyed by bucket-elevator to the classifier, where it is separated into fine and coarse material. The latter flows back into the mill.

The Classifier.

Fig. 2 (page 3) is a cross-section of an Escher-Wyss classifier. The supply of material falls through the inlet A on to the rotary distributing plate (1), is dispersed by the latter, and is flung into the space between the periphery of the distributing plate and the inner casing (2). Air propelled by a fan (3) flows through the material scattered in this way and carries with it the fine particles of material. This initiates the classifying process since the heavier particles of material fall downwards.

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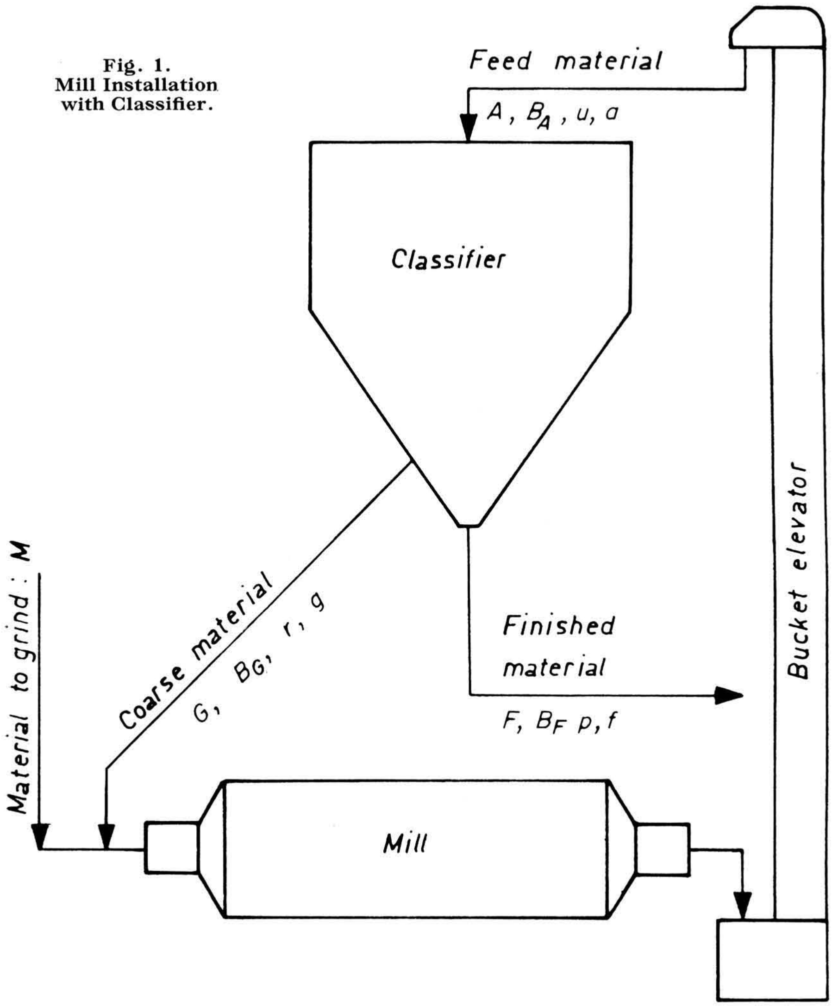
*Of Escher Wyss A.G., Zurich.

This article is a translation of a paper published in " Schweizerische Bauzeitung," February, 1967.

B

Fig. 1.
Mill Installation with Classifier.



The material borne upwards in the air stream now enters the main classifying zone. The main classification is effected by means of the selector fan (4) which considerably reinforces the rotary motion of the ascending air stream. This reinforced rotation about the axis of the classifier generates a centrifugal force on the particles, as a result of which the heavier particles are flung further outwards than the lighter particles and finally leave the ascending stream and fall under their own weight into the coarse-material outlet G. The fine dust flows with the surrounding air through the fan (3) and enters the separating chamber (5) at a tangent. The dust-air stream then spirals downwards at a high velocity, in which process the fine material is swirled against the wall of the exterior casing (6) and falls into the fine material outlet *F*. The surrounding air passes through stationary guide vanes (7) back into the inner casing (2).

The fineness of the finished product can be regulated to any degree desired either by increasing or decreasing the number of blades (8) on the selector fan (4), or by adjusting the damper (9) to obtain an even more sensitive degree of regulation of the fineness of the finished product.

Since in the ordinary type of classifier the finenesss over a wide range can be regulated only when the plant is not in operation, the Escher-Wyss classifier is fitted with another type of regulator. Directly below the selector fan (4) are guide vanes (10), which can at any time be adjusted to the required position by means of the adjusting lever (11) over a guide-wheel ring (12). The latter can be adjusted externally, even when the plant is operating, through the drive mechanism (13).

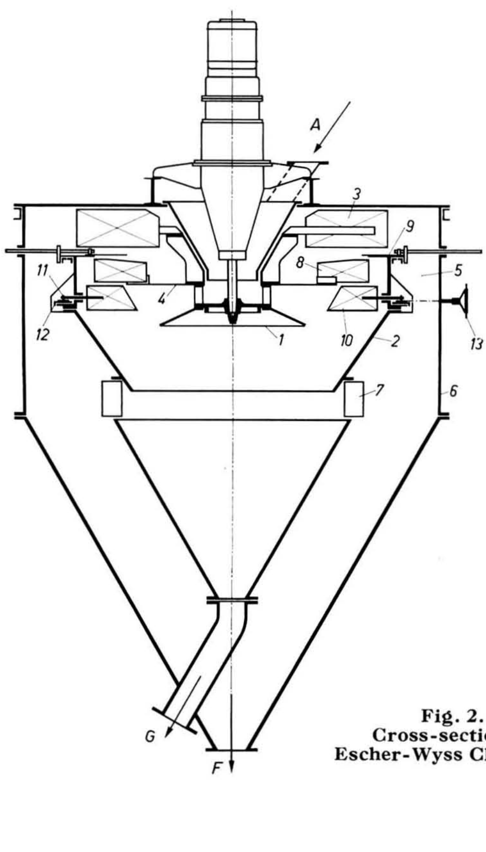
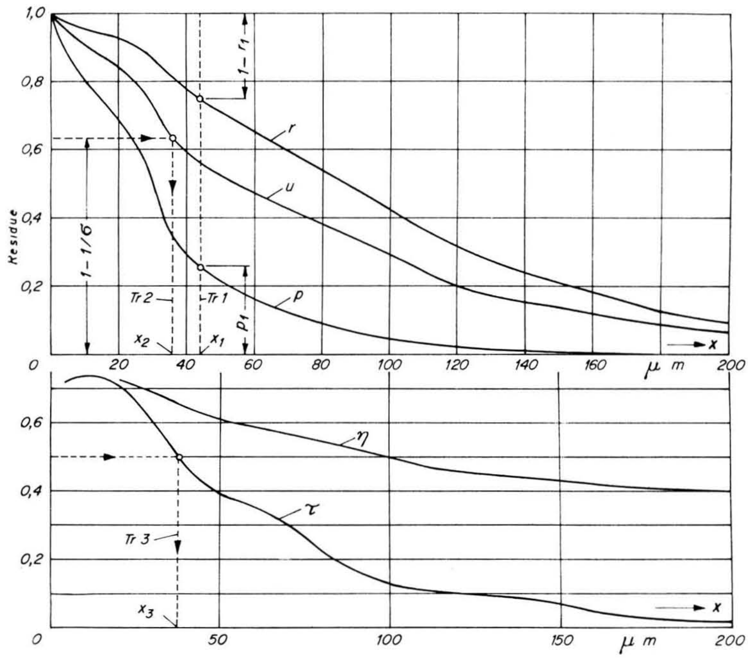


Fig. 2.
Cross-section of Escher-Wyss Classifier.



Granulation Curves

Separation

Fig. 3.—Determination of Separating Sizes T_r1. T_r2 and T_r3.

Granulation Curves.

In observations of existing plants, the grain analysis provides important information on the operating behaviour and more especially on the mode of operation of the classifier. By plotting the values obtained as a function of the size of grain x, the granulation curves (*Fig.* 3) are obtained. The calculation of the standard quantities is illustrated hereunder in a numerical example.

The classifier is fed with A tons of material per hour to be classified. Of this, it separates out F tons per hour as finished material (cement), while G tons per hour pass back again as coarse material into the mill. From these streams of material, the following two ratios can be obtained.

Circulation number: $\sigma = A/F$

Returned material number: $\rho = G/F$

Since $A = F + G$,

$$\sigma = 1 + \rho; \quad \rho = \sigma - 1.$$

For examination of the material, samples are taken and sifted out. The weight of the residue remaining on the sieve is set down in relation to the total weight of the sample and the following proportional values are thus obtained for the three streams of material.

For the product (finished material) .. .. .. p
For the quantity circulated (feed material) .. .. u
For the returned material (coarse material) .. .. r

For the passage through the sieve, the corresponding proportional values are as follows.

For the finished material .. .. .. $f = 1-p$
For the supply .. .. $a = 1-u$
For the coarse material .. .. .. $g = 1-r$

In each case according to the sieve selected, that size of grain x is obtained for which the measured values p, u and r are valid. The properties of three sieves commonly used are given in the following.

DIN No.	*Number of apertures per sq. cm.*	*Clear width x of mesh (mm)*	*Dia. of wire (mm.)*
30	900	0·200	0·131
70	4,900	0·088	0·055
100	10,000	0·06	0·04

With the finest sieve (DIN No. 100), $x = 0{\cdot}06$ mm. $= 60\mu m$. In order, however, to obtain granulation curves of the greatest possible range (that is as complete as possible), values of p, u and r are required for still smaller values of x. Dr. W. Wieland's grain analyser is capable of supplying the corresponding values down to $10\mu m$.

In addition to the proportional numbers, p, u and r and respectively f, a and g, the quantity of finished material, F tons per hour, and the Blaine values B are measured, namely:

For the finished material: B_F sq. cm. per gramme
For the supply: B_A ,, ,, ,, ,,
For the coarse material: B_G ,, ,, ,, ,,

The values σ and ρ can be expressed by means of the proportional values obtained from the sample test thus:

$$\rho = (p - u)/(u - s) \quad \ldots \quad (1)$$

$$\sigma = (r - p)/(r - u) \quad \ldots \quad (2)$$

The separating rate η of the classifier is expressed as the ratio of the fine constituent of the finished product to the fine constituent of the material fed into the classifier.

$$\eta = \frac{F_f}{A_a} = \frac{1}{\sigma} \cdot \frac{1 - p}{1 - u} \quad \ldots \quad (3)$$

In *Table I*, the measured values for p, u and r for three different sizes of grain x are tabulated together with the values for σ and η as calculated in accordance with the formulae (2) and (3).

When good grain analyses are available, the values of ρ and σ are independent of the size of grain. It may be assumed that any important variations are due to inaccuracies. It is rather difficult to obtain good conformity between the ρ and σ,

TABLE I—PARTICLE ANALYSIS AND VALUES OF σ AND η

x μm	60	88	200	Mean
p	0·158	0·064	0·001	
u	0·468	0·338	0·060	
r	0·656	0·488	0·096	
$r-p$	0·498	0·424	0·095	
$r-u$	0·188	0·150	0·036	
σ	2·65	2·82	2·64	2·7
η	0·59	0·54	0·39	

as the smallest error in the grain analysis has a great influence on the results. On the other hand, the separating rate η obtained in this way is dependent on the size of grain x on which it is measured.

A further check on the circulation number σ is possible with the aid of the Blaine values. If no new surface area is created in the sifter, then the incoming surface-area of the feed material must be equal to the sum of the surface-areas of the finished and coarse materials. Thus

$$AB_A = FB_F + GB_G$$

or $$\sigma B_A = B_F + (\sigma - 1)B_G.$$

Hence $$\sigma = (B_F - B_G)/(B_A - B_G).$$

Procedure for Estimating the Selectivity of a Classifier.

In order to be able to compare the efficiencies of various classifiers, it is usual to establish a separating size T_r on the basis of the granulation curves (*Fig.* 3). For this, the following methods are available.

(*a*) As the separating size, that size of grain as fixed, at which the proportionate residue of fine material is equal to the proportionate quantity of coarse material passing through the sifter, that is

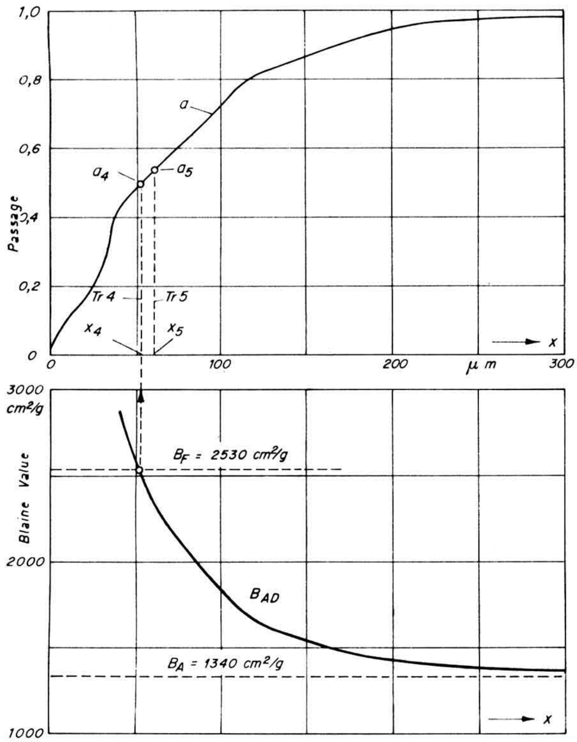
$$p_1 = 1 - r_1$$

This separation limit is marked in *Fig.* 3, and thus $T_r(1)$ at $x_1 = 44$ μm.

(*b*) In a second method, the separating size $T_r(2)$ is determined by comparing the entire quantity of the fine constituent in the coarse material with the quantity of coarse constituent in the fine material; and in fact the separating limit is precisely at that size of grain x, at which these two quantities are of equal magnitude. This equivalent sifting size of grain is found at that point on the granulation diagram, at which the oversize in the finished product, taken by weight, is equal to the undersize in the returned material, that is

$$p_2 = \rho\,(1 - r_2) \qquad (4)$$

or $\rho = p_2/(1 - r_2)$.



Curve for $(1-u)$

Blaine Value of Feed Material.

Fig. 4.—Determination of Separation Sizes T_r4 and T_r5.

From formulae (1) and (4)

$$u_2 = p_2/(1 - r_2 + p_2)$$

If the expressions for p_2 and u_2 are substituted in formula (3)

$$\eta = 1 - p_2 \text{ and } 1/\sigma = 1 - u_2 \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (5)$$

Formula (5) enables the equivalent separating size of grain to be found since, as shown in *Fig.* 3, the value $1/\sigma$ is represented horizontally on the granulation diagram. The point of intersection with the granulation curve for u (circulation) gives the equivalent separating size of grain, which in the present example is $x_2 = 36\mu\text{m}$.

(c) In a third procedure, the separating curve $z = f\ (x)$ is first drawn. This curve is also known as the distribution curve or the Tromp curve and, in the technology of dust collecting, as the fractional curve of the degree of dust collection. It gives the proportional constituent parts by weight going into the coarse or the fine material as a function of the size of grain x, so that

$$z = \frac{\text{Weight of grain size in the fine material}}{\text{Weight of grain size in the feed material}}$$

Moreover, from the measured values of p and u for the various graduations of grain size, the increments Δp and Δu are determined at these graduations. Consequently

$$z = \frac{F\Delta p}{A\Delta u} = \frac{1\Delta p}{\sigma\Delta u}.$$

The separating limit $T_r(3)$ is defined as that size of grain at which half of the grain of that size contained in the feed material reaches the finished material, and thus when $z = \frac{1}{2}$. From the shape of the classifying curves within certain fixed limits, for example between 0·35 and 0·65, the selectivity of the classifying process is established. In the lower part of *Fig.* 3, the separating curve corresponding to the granulation graphs is shown. The separating limit $T_r(3)$ is 38μm.

It is proposed to present a new definition of the separating limit $T_r(4)$ and of the degree of separation, and the corresponding values as found by experiment are also given. From this a method is subsequently developed which, as an approximate procedure, is claimed will make it possible to evaluate the behaviour of a classifier in operation. It is based solely on the Blaine values so that drawing and interpreting the granulation curves are unnecessary.

Separating Size of Grain as Determined from the Specific Surface.

As illustrated in *Fig.* 1, feed material of fineness B_A flows into the classifier. In each case, according to production requirements say, for standard or special cement, the classifier will be regulated so that the finished product is of a certain specified fineness B_F. Depending on further factors, such as particularly the loading of the classifier, the material fed in A will split up into the streams F and G, that is a definite circulation number σ (representing material in circulation through the classifier) and a definite fineness B_F will be established.

In the upper part of *Fig.* 4, the granulation curve $a = 1 - u$ corresponding to *Fig.* 3 is reproduced; the lower section represents the graph of the value B_{AD}, the specific-surface of the grains of feed material between 0 and x. This value can be determined, since the figure for the quantity passing through the sieve obtained from the sieving tests is subjected to further analysis for the Blaine value. Such measurements are seldom available. The curve B_{AD} can also be obtained by calculation, in which process, however, certain assumptions regarding form factor and specific weight of the cement must be made. In the lower part of *Fig.* 4, the B_{AD} curve is drawn which has been arrived at by calculation assuming a form factor of unity.

The B_{AD} curve, which for $u = 0$ is converted to the value B_A, can now be intersected at the value B_F, by which means the separating size x_4 (in the present example 52 μm) is obtained, that is, if the classifier at the point x_4 were to classify with absolutely precise selectivity, then it would deliver a finished product with the required value of B_F. At this point, the residue amounts to u_4 and the smallest possible circulation number is

$$\sigma M = 1/(1 - u_4).$$

The effective circulation number can be imagined as consisting of two factors

TABLE II.—SUMMARY OF TEST RESULTS OF VARIOUS MILL INSTALLATIONS

Installation Material ground Test No.			A Clinker 1	 2	 3	B Clinker 1	 2	C Clinker + scoria 1	 2	 3	 4	D Clinker 1
Composition (per cent.)		Clinker	89·4	89·2	94·5	—	—	48·5	48·5	48·5	24	—
		Scoria	4·7	5·0	—	—	—	48·5	48·5	48·5	73	—
		Gypsum	5·9	5·8	5·5	—	—	3·0	3·0	3·0	3	—
Classifier												
Quantity of finished material	F	t/h.	29·6	28·3	20·1	9·5	10.0	10·0	19·8	22·15	11·4	17·6
Ditto, fed to sister ..	A	t/h.	79·9	150·0	127·2	26·3	25·6	66	80	112	114	40·6
Circulation number	σ	—	2·7	5·32	6·34	2·77	2·56	6·6	4·02	5·05	10	2·31
Diameter of classifier	d	m.	4·8	4·8	4·8	3·6	3·6	4·8	4·8	4·8	4·8	4·2
Blaine value (finished) ..	B_F	sq. cm/g.	2,530	2,810	4,030	3,130	2,790	4,200	2,620	2,540	3,910	2,480
Blaine value (feed) .	B_A	sq. cm/g.	1,340	1,210	1,610	1,600	1,550	1,680	1,330	1,120	1,340	1,363
$\sigma_2 = B_F/B_A$		—	1·89	2.31	2·50	1·96	1·83	2·49	1·97	2·27	2·92	1·82
$\sigma_1 = \sigma/\sigma_2$		—	1·43	2·31	2·52	1·42	1·40	2·65	2·04	2·22	3·42	1·27
$1/\sigma_2$		—	0·53	0·43	0·4	0·51	0·55	0·4	0·51	0·44	0·34	0·55
$\xi = 1/\sigma_1$		—	0·70	0·43	0·4	0·70	0·72	0·38	0·49	0·45	0·29	0·79
σ_M		—	2·03	2·53	2·77	2·07	1·93	—	—	—	—	—
σ_S		—	1·33	2·12	2·29	1·34	1·33	—	—	—	—	—
η_B		—	0·75	0·47	0·44	0·75	0·75	—	—	—	—	—
$\kappa = (\sigma_2 - 1)/\sigma$ ..		—	0·33	0·245	0·237	0·348	0·325	0·225	0.24	0·252	0·192	0·355
$\kappa_B = (\sigma_M - 1)/\sigma$ ..		—	0·377	0·288	0·279	0·386	0·363	—	—	—	—	—
Mill												
Length/diameter ..	L/D	—		2·4		2·7			2·7			2·0
Ball charge ..		per cent.	30	30	30	—	—	27·3	27·3	30·2	30·2	24
Power consumption	N	kw.	750	750	750	275	275	602	607	640	621	475
N/d^3		kw/m³.	6·75	6·75	6·75	5·6	5·6	5·4	5·5	5·8	5·6	6·4

σ_M and σ_S, where σ_S represents the enlargement from σ_M and to σ due to the imperfect selectivity of the classifier. Therefore

$$\sigma = \sigma_M \sigma_S.$$

The separating efficiency obtained in this way from the Blaine values is shown by $\eta B = 1/\sigma_S$.

The evaluation in accordance with *Fig.* 4 gives the following values:

$$x_4 = 52\mu\text{m},\ a_4 = 0{\cdot}493,\ u_4 = 0{\cdot}507.$$

$$\sigma_M = 1/0{\cdot}493 = 2{\cdot}03.$$

$$\sigma = 2{\cdot}7 \text{ (established by grain analysis).}$$

$$\sigma_S = 2{\cdot}7/2{\cdot}03 = 1{\cdot}33\ \eta_B = 0{\cdot}75.$$

In *Table* 2, the results of experiments on four different Escher-Wyss grinding installations are tabulated in the upper part of the table and, in the lower part, the evaluation results are included. Only for installations A and B are complete grain analyses available. Consequently it was only for these tests that the values of σ_M, σ_S, η_B and x_B could be ascertained.

The ratio B_F/B_A obviously plays a very important role in a review of the performance of a classifier. In *Fig.* 5, σ_M is plotted as a function of B_F/B_A. Accordingly σ_M may be represented as a function of B_F/B_A, in all probability also for different installations. Further future measurements will have to show whether this assumption is admissible as sufficiently accurate. Should this be the case, then σ_M can be ascertained approximately from B_F/B_A.

Research into the separating effect η_B demands more extensive evaluation work, in addition to the collection of further Blaine measurements with the object of plotting the B_{AD} curve. Accordingly there is another simplified repre-

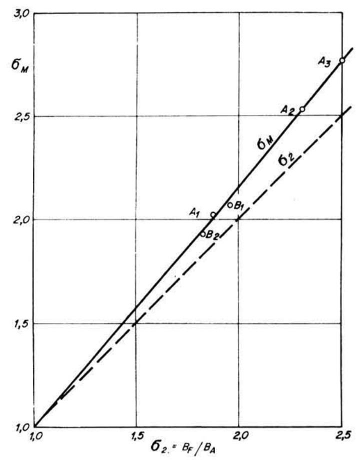


Fig. 5. Minimum Circulation Number.

sentational possibility, which, it is claimed, will make it possible to achieve an evaluation even in the absence of granulation curves.

Separating Effect as Obtained from the Specific Surface.

Let the separating effect be described as the ratio between the surface area separated out in the finished material from the classifier and the total surface area of the material fed into the sieve:

$$\Sigma = \frac{FB_F}{AB_A} = \frac{1}{\sigma} \cdot \frac{B_F}{B_A} \quad \text{or} \quad \sigma = \frac{1}{\Sigma} \cdot \frac{B_F}{B_A}.$$

Let the circulation number again be composed of two factors, $\sigma = \sigma_1 \sigma_2$ in which

$\sigma_1 = \frac{1}{\Sigma}$ and $\sigma_2 = \frac{B_F}{B_A}$.

The value of Σ will always be somewhat smaller than the value of η_B, since η represents the ratio of the separated surface area to the total supplied surface area, while η_B is the ratio of the separated surface to the theoretically separable surface under optimum conditions. It follows from this that the value σ_M is always greater than B_F/B_A. In the limiting case, where $B_F = B_A$, $\sigma_M = \sigma_2 = 1$ (*Fig.* 5).

If the evaluation is limited simply to determining the value of Σ and takes σ_2 as a basis for the determination of a given separating limit $T_r(5)$, then, as in formula (5),

$$\sigma_2 = \frac{1}{1 - u_5} \; ; \text{ or } \; a_5 = \frac{1}{\sigma_2}.$$

In *Fig.* 4, the separating limit $T_r(5)$ is plotted; as is seen, $x_5 = 60\mu\text{m}$.

In *Fig.* 6, the values obtained for Σ and η_B are plotted as a function of $1/\sigma_2$. The S-shape of the curve shows that, for high values of σ_2, the classifier operates

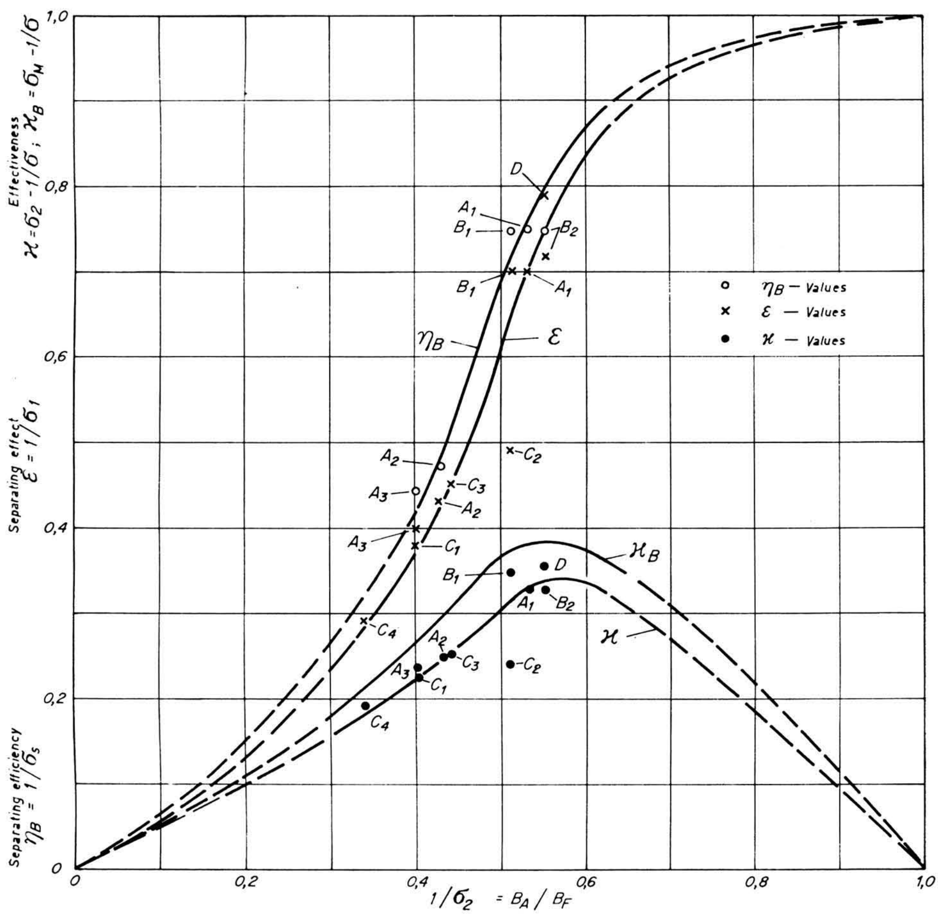


Fig. 6.—*See Table II.*

unsatisfactorily but for low values it is considerably more favourable.

In estimating the performance of a classifier, the values arrived at for η_B and Σ cannot alone be decisive. The circulation number σ, which is derived, is also specially dependent on the following quantities:

1.—On the ratio of the length to the diameter (L/D) of the ball-mill.

2.—On the charge factor of the mill.

3.—On the crushability of the clinker.

4.—On the required fineness of the finished product.

For example, if a large ratio L/D is selected, then σ_1, σ_2 and σ become small. If, in the limiting case, these values approach unity, the classifier can be replaced by a by-pass. The classifier is thus ineffective. So that the question of the effectiveness of the classifier arises.

Effectiveness of a Classifier.

It follows from the foregoing, that the greater the fineness ratio B_F/B_A demanded of a classifier, the greater the circulation number σ becomes and the smaller Σ becomes. The effectiveness x must consequently be represented by

$$x = \frac{\sigma_2 - 1}{\sigma_2}\,\Sigma = \frac{\sigma_2 - 1}{\sigma_2 \sigma_1} = \frac{\sigma_2 - 1}{\sigma}.$$

Proceeding from the value σ_M, then the analogous formula for the effectiveness is

$$x_B = \frac{\sigma_M - 1}{\sigma}.$$

In *Fig.* 6, the x-curve and the x_B curve are drawn. They show a maximum at $1/\sigma_2 = 0{\cdot}5$ to $0{\cdot}6$ and fall away towards zero when $1/\sigma_2 = 0$ and $1/\sigma_2 = 1$.

In conclusion it should be noted also that for the curves shown in *Figs.* 5 and 6, only a relatively small number of tests were available and these were conducted under more or less similar conditions, which were principally as follows.

1. Rotary-kiln clinker.
2. L/D between 2·0 and 2·7; hence relatively short ball-mills.
3. Ball charge from 24 to 30 per cent.
4. Output of the mill in relation to size of the sifter: $N/d^3 = 5{\cdot}4$ to $6{\cdot}75$.
5. Similar type of classifier and mill.

In no sense, therefore, can universal validity be claimed for the curves in *Figs.* 5 and 6. It is anticipated that, when new test results become available, further research in the direction indicated will be carried out.

It should be mentioned again that the granulation curves of installations *A* and *B* (*Table II*) were measured with a Dr. W. Wieland grain-analyser. The initial values for all installations A, B, C and D are based on test results from the Holderbank Technical Office. The author would like to take this opportunity of expressing his thanks for this information.

Summary.

The matter can be summarised by stating that the estimation of the performance of a classifier by the proposed use of the separating limits $T_r(4)$ and $T_r(5)$ is done with reference to an important requirement, namely, the fineness ratio σ_2 of the classifier. The values of η_B, Σ, x_B and x are represented as functions of σ_2 and/or its reciprocal value $1/\sigma_2$. The evaluation of test results shows that mean curves can be drawn without undue scatter of points. Should a measured point lie above these curves, then the classifier is working more satisfactorily, and *vice versa*. If the values of B_F, B_A and σ (circulation number) are known for a classifier, then an approximate estimate of performance by the procedure indicated above is already possible.

Some New Cement Works.

Some of the many new cement works, or extensions to existing works, that have been established recently or are under construction in the United Kingdom and in other parts of the world are described briefly in the following.

Cookstown Works, Northern Ireland.

A new cement works having an annual productive capacity of 300,000 tons is now under construction for the Blue Circle Group, at Cookstown in Northern Ireland. A photograph of a model of the new works is reproduced in *Fig.* 1 on page 14. The site is located ten miles west of Lough Neagh in Co. Tyrone and is forty-six miles by road from Belfast. Construction commenced in 1967, and it is expected that production will begin in August this year. The works will operate on the semi-dry process as adopted at the Group's latest works at Dunbar (Scotland) and Weardale (Co. Durham); the latter two works were described in the numbers of this journal for January 1964 and July and September 1966 respectively.

The civil engineering work is being designed by the consulting engineers Messrs. Oscar Faber & Partners in association with the Central Engineering Department of The Associated Portland Cement Manufacturers Ltd., under the overall control of the Northern Area Engineer's Department, which Department is also responsible for all the mechanical and electrical engineering for the project. The civil engineering work includes a cast-insitu reinforced concrete chimney 300 ft. high. The diameter of the shaft varies from 23 ft. at the bottom to 9 ft. 6 in. at the top, the thickness of the wall varying from 9½ in. to 5 in. It is intended that this structure, which is similar to others at other recently-established works of the Blue Circle Group and is expected to be completed this Spring, will be used by the consulting engineers for structural research into concrete chimneys.

The main civil engineering contractors are Sir Lindsay Parkinson & Co., Ltd., which firm is also undertaking the bulk excavation at the site of the limestone crushing plant. The contractors for the bulk excavation at the site of the works and for roads, drains and the like, are Messrs. McLaughlin & Harvey Ltd. The chimney is being constructed by Messrs. Bierrum & Partners Ltd.

Messrs. Ashmore, Benson, Pease & Co., Ltd., a member of the Davy-Ashmore Group, are supplying an "Aerofall" mill of 23 ft. diameter and the associated air-system for the works. This plant is to be used in the production of the limestone raw meal and is the fourth "Aerofall" mill to be installed by The Associated Portland Cement Manufacturers Ltd., the other mills being at the works at Cauldon, Dunbar and Weardale. The gas cleaning equipment for the new kiln is to be installed by Sturtevant Engineering Co., Ltd., a member of the Drake & Gorham, Scull Group.

Extension of Pitstone Works.

An extension costing about £7,000,000 is being made to the works of the Tunnel Portland Cement Co., at Pitstone, Buckinghamshire. The extension will increase the annual productive capacity of the works by more than 400,000 tons

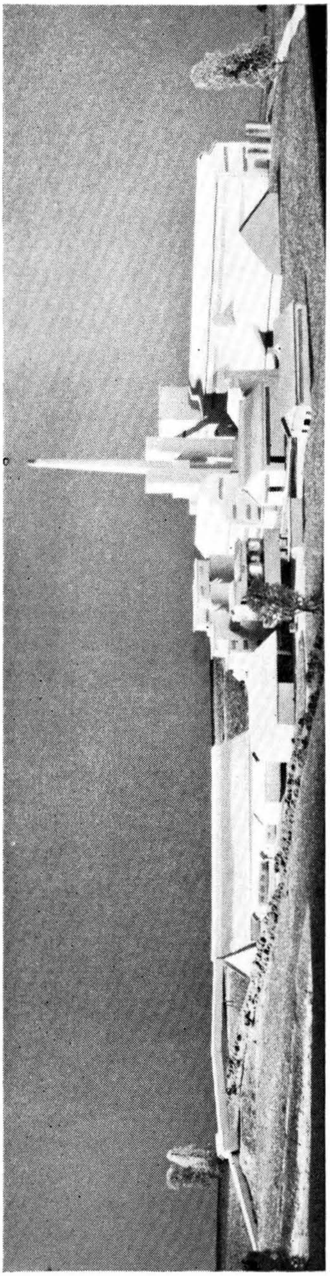


Fig. 1.—Cookstown Works, Northern Ireland. (Photograph of Model.)

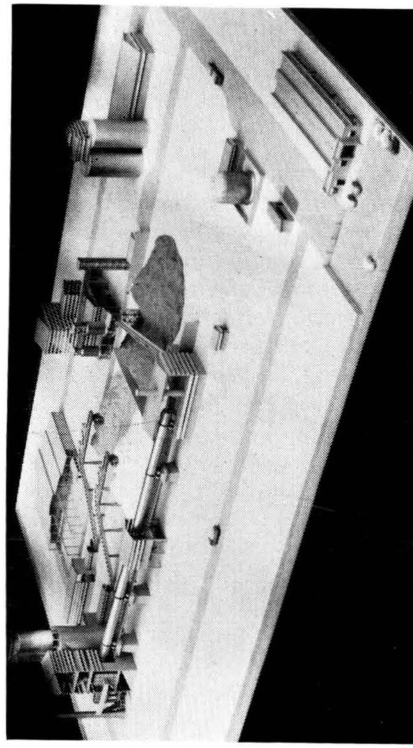
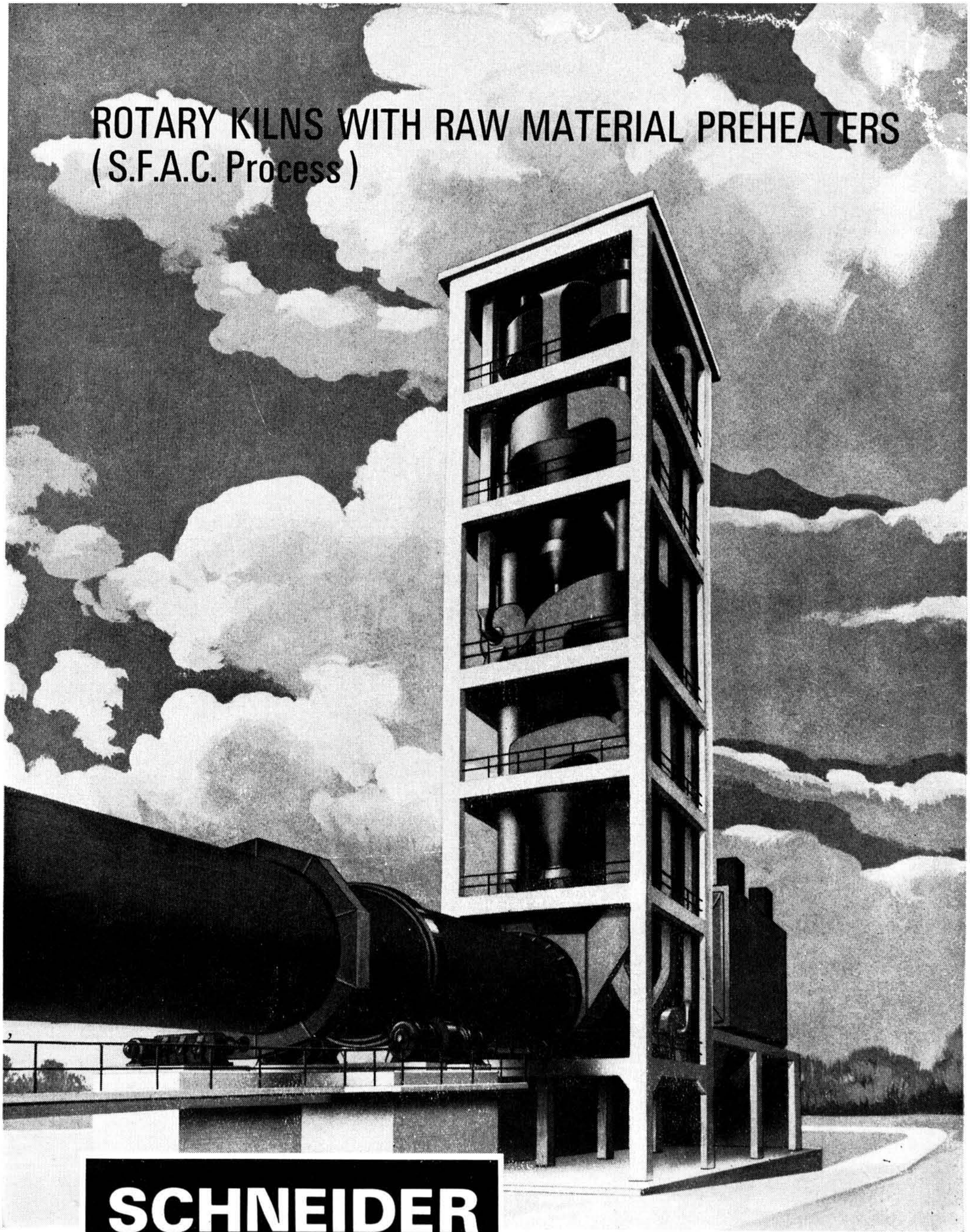


Fig. 2.
New Works in Qatar.
(Photograph of Model.)


ROTARY KILNS WITH RAW MATERIAL PREHEATERS
(S.F.A.C. Process)

to a total of about 1,000,000 tons. It is expected that the new plant will reach full capacity by mid-1969. When the Pitstone works reaches full production, the Tunnel Portland Cement Co., claim it will have, together with their works at West Thurrock, the two largest cement works in the United Kingdom.

In preparing the plans for the extension, a perspective view of which is shown in *Fig.* 3 on page 16, special attention is being given to preserving local amenities. Over £700,000 is being spent on dust-precipitation plant and this sum includes £350,000 to be spent on the existing plant to improve the level of dust filtration. Three electrical precipitators are being installed, one of which will be a stand-by.

The main features of the new plant, which will be highly automated, include a rotary kiln 430 ft. long, and a reinforced concrete chimney 350 ft. high. There will be about 16,000 ft. of conveyor-belts linking the new kiln (No. 5) with the chalk quarries and the raw-material stores. The kiln house is 1,800 ft. long and 500 ft. wide. The substructure will be of reinforced concrete with a steelwork housing above. The kiln will be the largest installed for the dry process. The cost of the kiln house and substructure will be about £2,000,000.

Special landscaping is to be carried out and tree-planting has been undertaken in order to mask the works from the adjacent village and from two local beauty spots. Full screening is not practicable but the plantings are planned to hide many of the low structures, so that only the chimney and silos will rise above the tops of the trees.

Attention is also being given to noise reduction and certain sections of the works will be sound insulated. New and highly economic methods of quarrying are being introduced and these will also reduce the noise. New bucket-wheel excavators that can excavate 500 tons per hour are being brought into service, and work at night at the quarries will be reduced when the extension comes into production. A liaison committee on which the Rural, Urban District and Parish Councils, and preservation and amenities societies are represented, has been formed by the Buckinghamshire County Council and the Tunnel Portland Cement Co., Ltd.

The original Pitstone works was opened in 1937 and employed a staff of 350. With the commissioning of the new kiln, the output of the entire range of cements made by the Tunnel Cement Co., will be substantially increased.

The consulting engineers for the extension are Sir Frederick Snow & Partners, and the consulting architects are Messrs. Edward D. Mills & Partners. The landscape architect is Mrs. S. M. Haywood. The cement plant is being supplied by Messrs. F. L. Smidth & Co., Ltd.

The contract for the first phase of the extension which is expected to be completed by April this year has been awarded to Cementation Construction Ltd. This work, the value of which is about £350,000, includes general site levelling, roads and drains, a service duct 3,600 ft. long, and foundations, conveyor tunnels and the superstructure for a clinker and gypsum store. An interesting aspect of the work is that, in view of the impending change to the metric system, most of the working drawings are being dimensioned in that system.

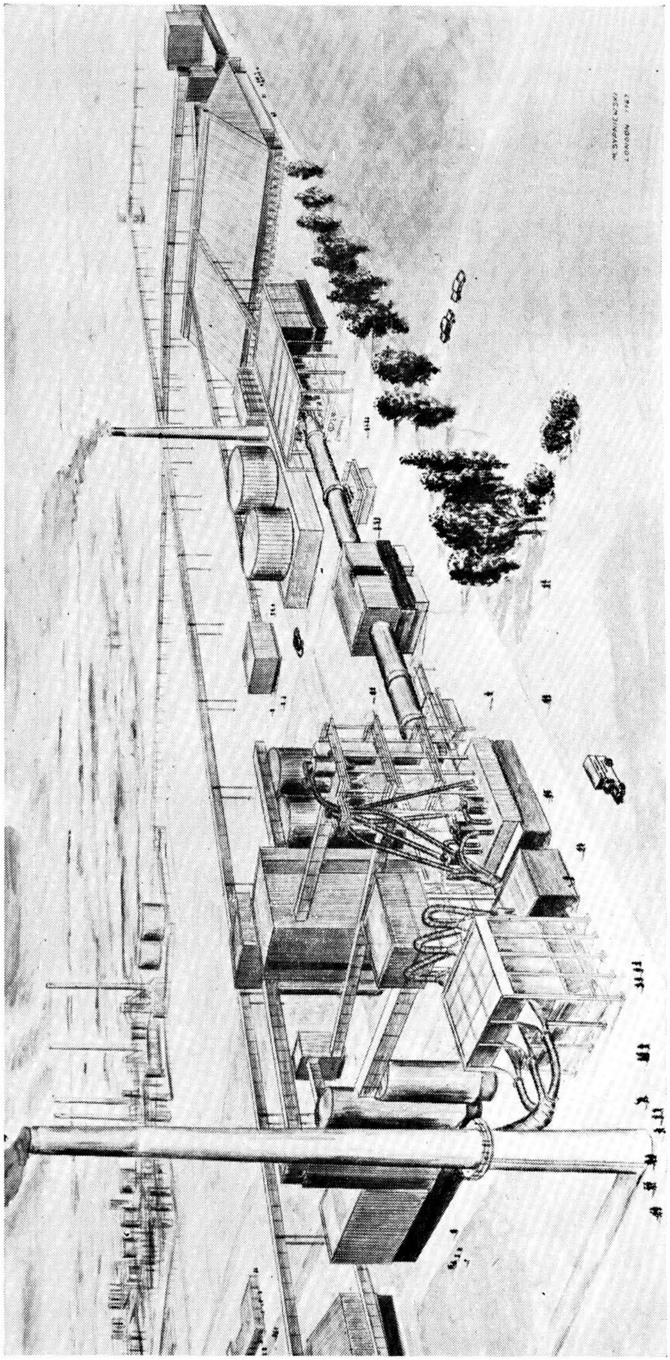


Fig. 3.—Reproduction of Perspective of Extension to Pitstone Works.

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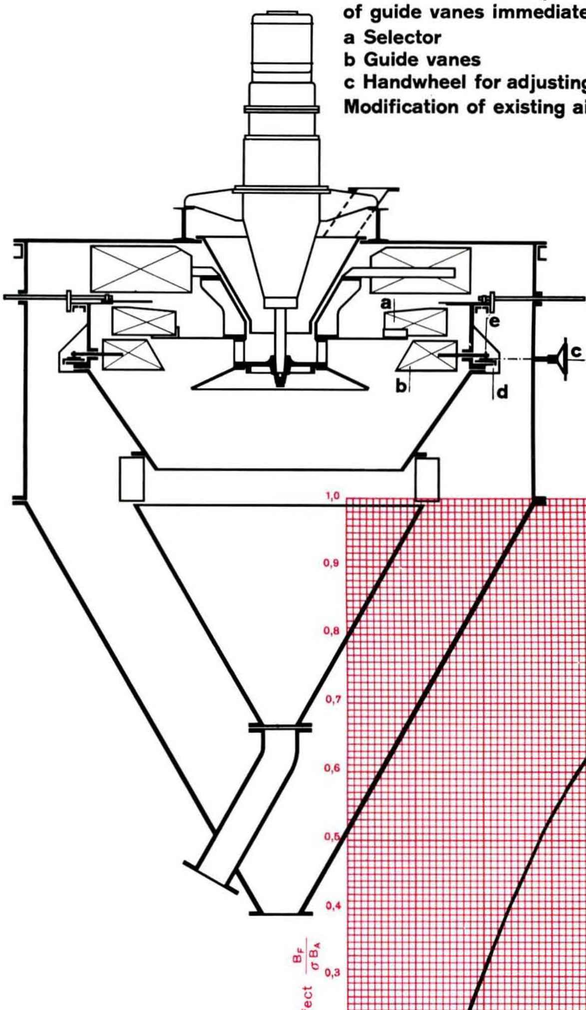

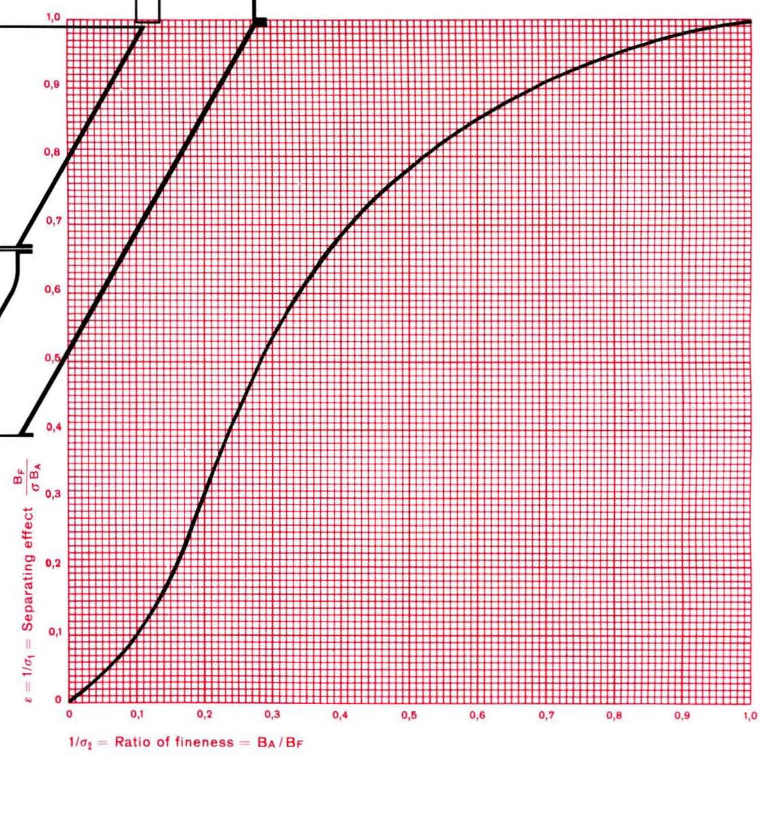

σ = Circulation number = A/F
A = Material separated in t/hr.
F = Finished product in t/hr.
B_A = Fineness of incoming product in cm²/g Blaine
B_F = Fineness of finished product in cm²/g Blaine
$1/\sigma_2$ = B_A / B_F

New Cement Works in Qatar.

The Qatar Government has announced the completion of the first phase of the £2,500,000 cement-manufacturing complex near Umm Bab, on the west coast of the Qatar peninsula. This phase comprises housing and residential services that will be used first by the constructors of the cement works and later by the operatives at the works. The project is the first major industrial venture undertaken by this State, except for international oil recovery, and is part of a diversification programme to reduce long-term dependence on oil revenues. It also represents a pioneering division of capital between the government and the Qatari public that resulted in the formation of the Qatar National Cement Manufacturing Co., in 1965. A photograph of a model of the new works is reproduced on page 14 (*Fig.* 2)

Messrs. Henry Pooley are the overall consulting engineers and this organisation confirmed the existence of limestone and shale deposits in the desert near Umm Bab, which is on the west coast of the Arabian Gulf; the estimated quantities are 22,000,000 tons and 7,000,000 tons respectively. The main machinery is being supplied by Franco-Tosi S.p.A. of Italy. The plant was transported by sea to a natural basin three miles from Doha, the capital of Qatar, and was then conveyed by lorries a distance of fifty miles over desert.

A complete gas-turbine power station of 3,300-kw. capacity is being installed by Messrs. Ruston & Hornsby Ltd. The power station will run on natural gas and will supply power to the woıks and the housing compound. The equipment will comprise three A.C. generators, each rated at 1,100 kw. The gas-fuel will be conveyed in pipes from a de-gassing station at an oil-field five miles away.

The plant includes raw-material crushers, conveyors, mills, a gas-fired rotary kiln, silos, packing machinery, steel-framed buildings and electrical equipment. The dry-process will be employed because of a shortage of suitable water. The annual productive capacity of the works will be 100,000 tons. Ordinary Portland and sulphate-resistant cements to British and U.S.A. standards will be produced. Production is expected to begin in the latter part of 1968. About two hundred men will be employed. The civil engineering work has progressed so far that construction of the foundations is nearing completion.

World's Largest Cement Kiln in the U.S.A.

The Dundee Cement Co., of Clarksville, Missouri, U.S.A., have installed what is reputed to be the world's largest cement kiln, having an annual productive capacity of 7,000,000 barrels (1,167,000 tons). The company believe that economies gained through large-volume production at one works will more than offset the high cost of transportation to distant users.

The new plant, it is reported in " Business Week," cost £4,000,000 and may revolutionise the U.S.A. cement industry, since up to now, most cement-makers have installed kilns of 1,000,000 barrels capacity, such being large enough to serve customers within a 100-mile radius; beyond this distance, the cost of transportation is considered to be excessive. The Dundee Cement Co., believe it would cost less to install one plant producing 6,000,000 barrels, rather than six plants each producing 1,000,000 barrels, but the large output of the larger installation would have to be marketed over a far larger area than is customary. The solution to this problem is warehousing. Supply depots have been established in six cities each 250 miles from the Dundee Cement Co.'s works. Transportation costs from kiln to depot are covered by savings in production costs. Each depot supplies customers within a 100-mile radius. These and other innovations in distribution enabled Dundee Cement Co. to sell at capacity last year compared with 80 per cent. for the rest of the U.S.A. cement industry.

ENCI Works, Holland.

For the expansion of the works of ENCI, at Maastricht, the largest cement manufacturers in Holland, a British-made excavator has been obtained. The machine is a Ruston-Bucyrus 110-RB Ward-Leonard electric excavator with an improved control system which has been developed in conjunction with Associated Electrical Industries Ltd. The machine, the value of which is over £82,000, will be used to extract up to 1,000,000 tons of limestone annually. Extensive expansion of the cement works is currently in progress to meet increasing demands for high-grade cement. ENCI claim to supply 90 per cent. of the cement requirements in Holland.

Limhann Works, Sweden.

It was announced recently that Skanskä Cement have completed a project costing nearly £10,000,000, which has increased the annual productive capacity of the Limhann cement works by 70 per cent. to 1,200,000 tons. This works, which is the largest cement works in Sweden, operates on a computer-controlled process, the control including the chemical and physical composition of the products.

East Germany.

A new cement works, the cost of which will be about £6,000,000, is about to be put in full operation at Ruedersdorf, near Berlin. One of the six kilns is already operating. All the productive processes are computer controlled. This works will also supply the building, agriculture and chemical industries of East Germany with 300,000 tons of high-grade lime annually.

Cement Mills of 3,000 h.p.

WITH reference to the article in the number of this journal for November last describing the new 3,000-h.p. grinding mills being installed by The Associated Portland Cement Manufacturers Ltd., it should be mentioned that the second chamber of each of the three mills so far in use is charged with steel balls manufactured by a new rolling process developed by Helipebs Ltd. This firm reports that after the first 4,000 hours of running of the mill at one of the works, the balls showed an exceedingly small amount of wear.

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