No. 3/4 TECHNICAL REVIEW 1944

SULZER

SULZER BROTHERS LIMITED, WINTERTHUR, SWITZERLAND

LONDON: SULZER BROS. (LONDON) LTD. — PARIS: COMPAGNIE DE CONSTRUCTION MÉCANIQUE PROCÉDÉS SULZER
BUCHAREST: SULZER FRÈRES, SOCIÉTÉ ANONYME — CAIRO: SULZER FRÈRES — MANILA: SULZER BROTHERS INC.
SHANGHAI: SULZER BROTHERS — KOBE: SULZER BROTHERS ENGINEERING OFFICE — NEW YORK: SULZER BROS. LTD. — RIO DE JANEIRO: SULZER FRÈRES S.A. — BUENOS AIRES: SULZER HERMANOS, SOCIEDAD IMPORTADORA LTDA.

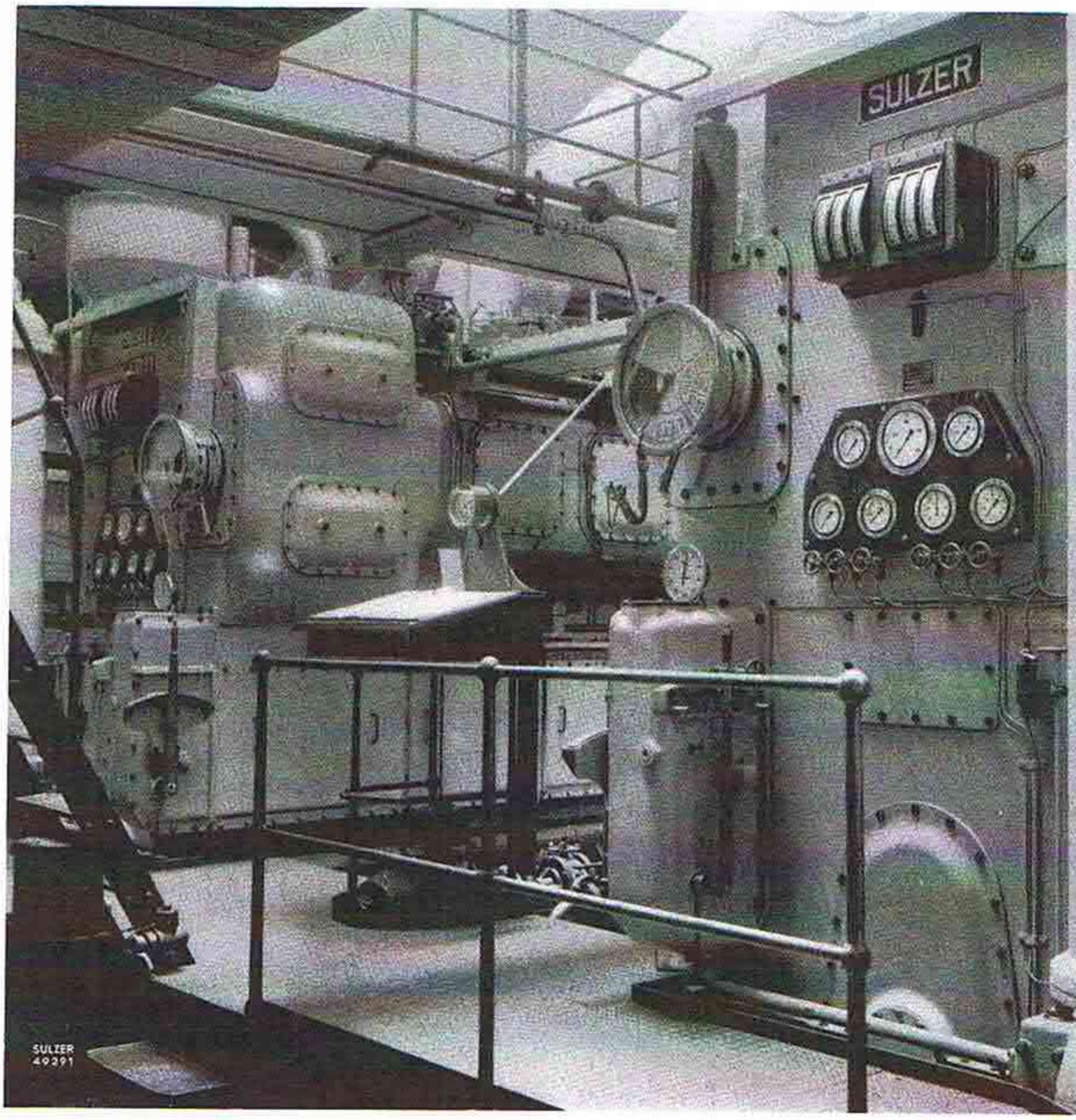


Fig. 1. Manoeuvring stand of the two 1200-B.H.P. Sulzer two-stroke engines installed in the M.S. "Säntis". The vessel is owned by the Federal War Transport Office of Switzerland. (See description of the plant on page 8.)

The New Engines of the M.S. "Säntis"

WHEN the shortage of shipping space and the insecurity of trading routes occasioned by the war threatened to deprive Switzerland of supplies from overseas, the Federal Office for War Transport in Berne decided to confront the emergency by the creation of a Swiss merchant navy, however modest. Among other vessels then bought was the British-built twin-screw motorship "Norseland", ex "Falstria", which today bears the name of M.S. "Säntis" and sails under the Swiss flag (fig. 13). With a length of 366 ft. and a beam of 50 ft., the vessel has a gross tonnage of 4349 register tons and a deadweight capacity of 6690 tons.

The Diesel plant of the vessel consisted of two four-stroke main engines of foreign make, which ran at a nominal speed of 145 revs. per min. and developed in all 2250 B.H.P., and two four-stroke auxiliary engines of 150 B.H.P. each for driving the two 100-kW direct-current generators and the compressors for the starting and injection air of the main and auxiliary engines. Further, apart from the usual small pumps for delivering fuel, lubricant, ballast, drinking water, etc., there was an engine with hot-bulb ignition coupled to an 11-kW generator for feeding the lighting mains. The following figures are also available, being taken from a record of the trial run on the 18th March, 1915: At a speed of 10.9 knots the fuel consumption of the propelling engines ran to about 192 grams per B.H.P.-hour. The Diesel plant occupied a roughly square floor area totalling about 2745 sq.ft., and this space was utilised to the full.

After some urgent overhauls, for the supervision of which Sulzer Brothers placed one of their erectors at the disposal of the War Transport Office, the vessel took over its new duties. A few Atlantic crossings, however, demonstrated that the two auxiliary engines were no longer equal to heavy service. Trouble with the governing system and the exhaust valves, hot running and damage to the journal bearings, inadmissible wear on the camshafts and other evils led to failure of the auxi-

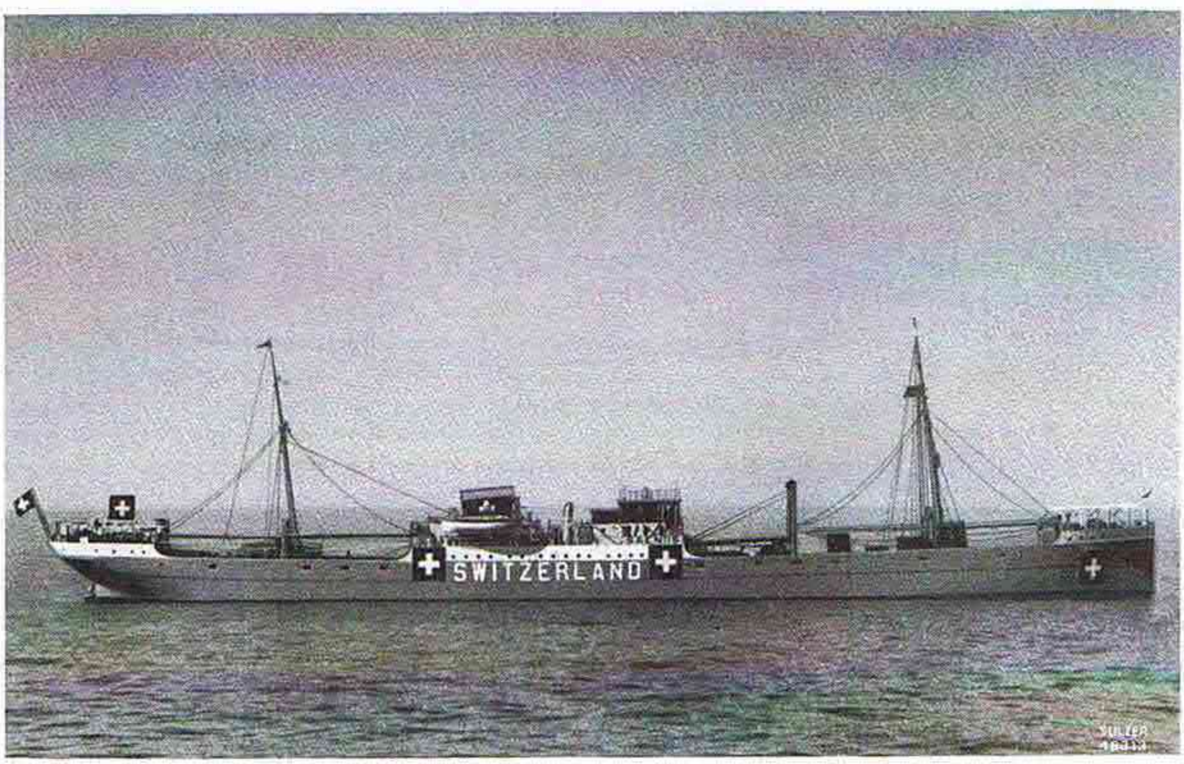


Fig. 13. M.S. "Säntis", now serving as part of the small merchant fleet of the Federal War Transport Office of Switzerland. She is equipped with two six-cylinder Sulzer two-stroke trunk-piston engines each developing 1200 B.H.P.

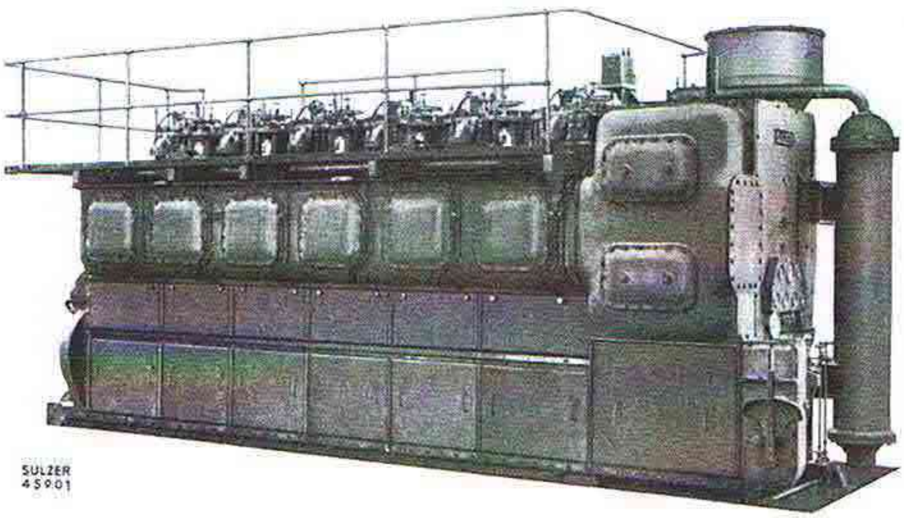


Fig. 14. One of the two 1200-B.H.P. Sulzer Diesel propulsion engines of the M.S. "Säntis".

liary engines, sometimes before any big distance had been covered. This jeopardised the whole plant, as the pumps for the cooling water and lubricating oil and the fuel supply for the main engines were electrically operated and dependent for current on these auxiliary sets. The ship repeatedly got into grave difficulties as a result, for it is a duty of neutral vessels during the war to sail fully lighted, in order to avoid the danger of being torpedoed by the naval forces of belligerent powers. As the risk to human life, to the vessel itself and to its vital freight could not be further tolerated, the War Transport Office decided in favour of complete replacement of the auxiliary plant. The building of the new engines was entrusted to Sulzer Brothers, who, after careful study of the space conditions, elected to supply the plant described below.

The two old auxiliary engines were replaced by three new Diesel dynamo sets each developing 120 B.H.P., two of these being coupled to compressors for filling the starting-air bottles (figs. 15 and 16). The connection between the engine and compressor shafts is effected by means of a Klus disengaging coupling supplied by the Louis de Roll Iron Works. These Diesel dynamo sets are single-acting four-stroke engines with cylinders in line and direct fuel injection, and are rigidly coupled to 220-volt Brown Boveri direct-current generators. They are started with compressed air.

A two-cylinder two-stroke engine (fig. 17) was chosen to take the place of the hot-bulb engine. The dynamo was again supplied by Brown, Boveri & Co., Baden. The Diesel engine is an opposed-piston model with horizontal cylinders, which differs from other opposed-piston types in having one crankshaft only. The power developed is transmitted from the pistons to the crankshaft through rocking levers. The opposed motions of the reciprocating elements serve to balance the masses involved to a great extent and make the engine run with gratifying smoothness. At a speed of 800 revs. per min. the set develops 32 B.H.P. and is mainly employed for feeding the 110-volt lighting mains. The engine can be cranked up with a starting handle like a car-motor, and in case of emergency is thus ready at a moment's notice to take over not only the generation of lighting current but also the drive of the emergency compressor for charging the air-bottles.

At the same time, a reconditioning of the main engines was considered, as these had also provided cause for serious misgivings. Cracks in cylinder jackets and covers, difficulties in reversing, frequent leakiness of the exhaust valves, bearing wear and signs of corrosion all went to prove that a complete overhaul of the engines was indispensable. Estimates of the costs involved, however, showed such a procedure to be unjustifiable, so that it was finally decided to replace the two main engines along with the others. The building of the new plant was again placed in the hands of Sulzer Brothers, Winterthur (see fig. 1 and front inside cover). In this work the fulfilment of two conditions was required. In the first place the propellers of the vessel, together with all shafting, were to be retained, as they were still in good condition and two spare propellers were also available on board. In the second place the speed of the vessel was to be increased so that her voyage times could be cut down, allowances naturally being made for the age of the ship.

The available space and the dimensions of the

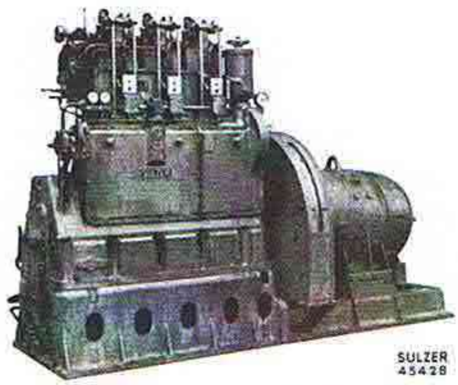


Fig. 15. Auxiliary set with a Sulzer four-stroke Diesel engine developing 120 B.H.P. at 500 revs. per min., coupled to a 220-volt, 70-kW direct-current generator.

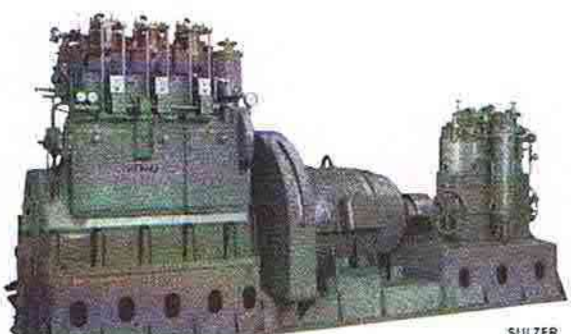


Fig. 16. One of the auxiliary sets, consisting of a Sulzer four-stroke Diesel engine developing 120 B.H.P. at 500 revs. per min., coupled to a direct-current dynamo of 220 volts, 70 kW, and to a Sulzer starting-air compressor. The latter is driven through a clutch coupling.

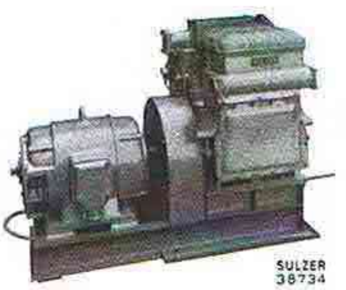


Fig. 17. Auxiliary set consisting of a Sulzer two-stroke opposed-piston engine developing 32 B.H.P. at 800 revs. per min., coupled to a direct-current dynamo of 110 volts and 18 kW.

bedplates suggested trunk-piston engines (fig. 14) as the most suitable propulsion plant. At a speed of 150 revs. per min. — which is certainly somewhat low for them — these engines develop 1200 B.H.P. each. This still leaves open the possibility of increasing the speed to the customary 225 revs. per min. later on when new propellers are installed, in which case the engine power would be increased by a considerable margin. Below are given some further details of the engine design.

A conspicuous feature of the propulsion Diesel engine is the lowness of its structure. This advantage of the trunk-piston engine allows it to be installed even where height is restricted. The same picture (fig. 14) illustrates the neat form of the external casing, which gives the engine a quiet, compact outline. The oil-cooled trunk piston, which serves at the same time as a power transmitting means and control member for the alternating process of exhausting gas and taking in combustion air, runs in an interchangeable liner. The frame, which is essentially of the approved A-shape, has a bulge on the scavenge side to take the camshaft and the fuel pumps. The bedplate, frame and cylinder block are braced by tie-rods. The crankshaft has eight bearings and is supported on the bedplate, which had to be designed with due regard for the height of the propeller shaft above the engine foundation. The engine has a separate fuel pump for each cylinder. This arrangement permits the use of short fuel pipes with small pressure losses. The scavening and charging of the cylinder with fresh air is based on the established Sulzer principle of extra-charging. The scavenge ports are placed in two rows lying one above the other and are controlled by non-return valves. The cylinder is thus given an extra charge of fresh air when the rising piston has already covered the exhaust ports, and this ensures an ample supply of fresh air for the combustion process. The non-return valves prevent exhaust gases from flowing into the fresh-air pipe when the piston is on its downward stroke. These valves are readily accessible from the outside when the casing covers have been removed, as are also the fuel pumps below and the camshaft. The fuel pumps can be supervised, moreover, even when the engine is running.

Attendance on the engine is simple, and is facilitated in particular by the neat arrangement of the manoeuvring stand (see figs. 1 and 14). The fuel lever, partly hidden in fig. 14, is connected through linkage to the piston-type fuel pumps which are regulated by varying the fuel quantity drawn in. Between fuel lever and fuel pump is a centrifugal governor which takes effect in case of sudden and undesirable increases of speed — occasioned, for instance, by the emergence of the ship's screw from the water in high seas — and at once throttles the fuel quantity delivered, so as to prevent the engine racing. (The manoeuvring lever used for starting and reversing can clearly be seen to the right in fig. 14. An instrument board allows oil pressures, temperatures, etc., to be supervised.) The new engine differs from the original one in having the gear-type pumps for the lubricating and piston-cooling oil driven direct from the engine, so that a failure of the oil circulation as a result of trouble in the generator set cannot occur. The cooling water for engine and oil cooler, however, is supplied by a pump with separate drive.

It was an obvious measure to remove the out-of-date thrust bearings when dismantling the old engines. These bearings, which took the thrust of the screw, were still of the multiple-disc type — a design which our present knowledge of the processes in plain bearings shows to be unacceptable. The frequent trouble experienced with the old bearings, in spite of their very moderate loading, confirms this view. The newly installed Mitchell bearings, which have given good results generally, are bolted direct to the bedplates of the engines.

In the course of the reconditioning of the "Säntis" plant — which had thus become somewhat far-reaching — the switchboard for the whole electric equipment of the vessel was also replaced by a new one supplied by Brown, Boveri & Co. Sulzer Brothers also provided two new cooling-water pumps for the main and auxiliary engines and an 11-kW rotary converter, as well as other minor equipment.

In spite of the increased power, a comparison of the new plant with the old shows a gratifying saving of space. The fact that the total plant weight has been cut down by about 186 tons is a further gain which goes to improve the ship's carrying capacity. At a specific fuel consumption at full load of 161 grams per B.H.P.-hour for the main and 172 grams per B.H.P.-hour for the auxiliary engines, the total fuel consumption in a full service day amounts to about 8 tons, as compared with 9.6 tons for the old plant. For these figures an average output of 2000 B.H.P. is assumed. As the vessel is capable of carrying 840 tons of fuel, its radius of action reaches the impressive figure of about 27,000 sea miles.

The War Transport Office in Berne had arranged with Sulzer Brothers a term of delivery of six months only, as the replacement of the main engines was becoming urgent. The fact that so short a term was kept to is witness to the efficiency and resources of Swiss industry.

The Heat Pump in the Service of Production

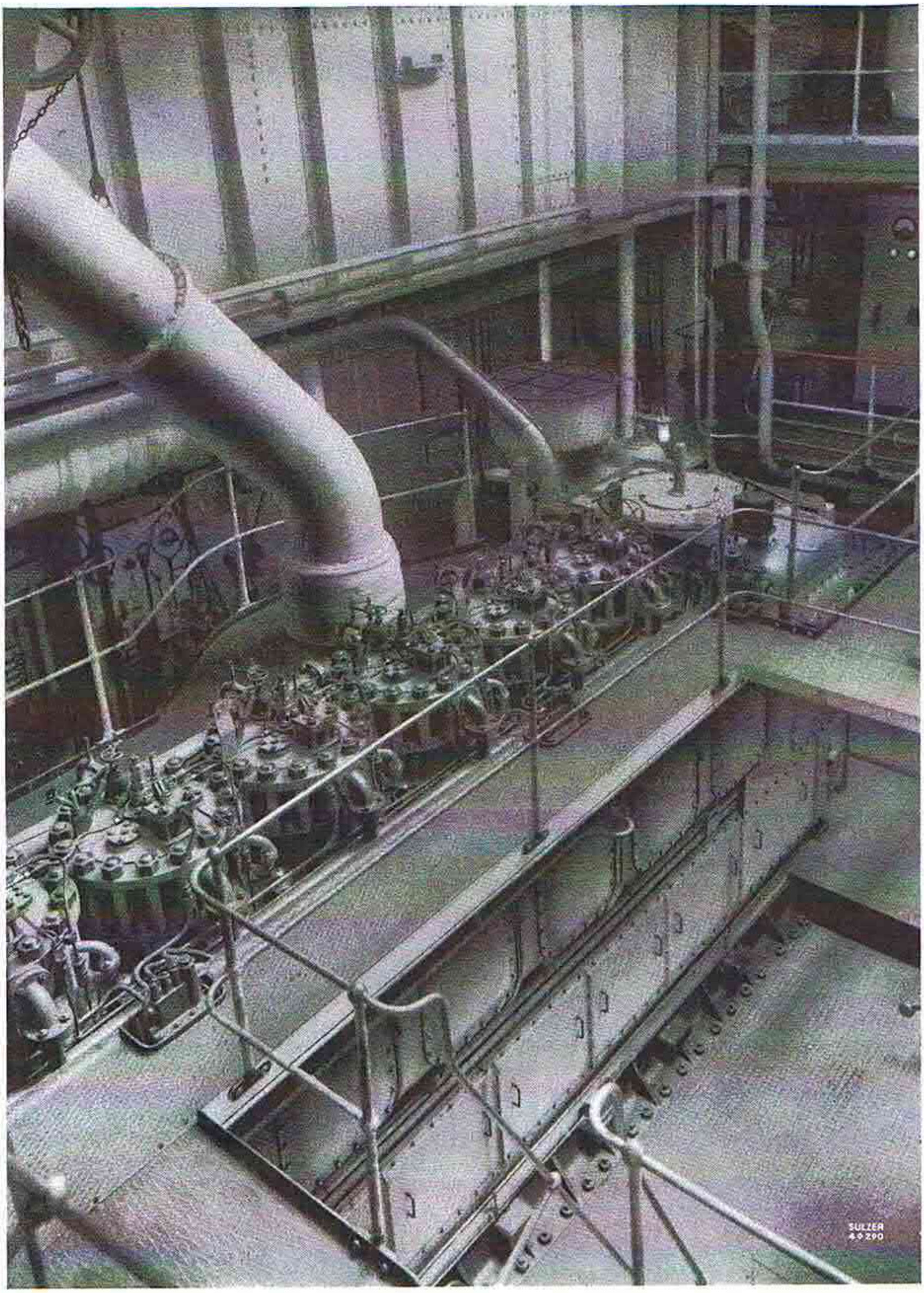
Wherever large quantities of heat are required at a moderate temperature (below 100° C), it is worth while to investigate the possibility of employing a heat pump. The following article describes an example of energy saving in a Sulzer installation of this type.

THE firm of Messrs. Bell A.G. of Basle, butchers and sausage manufacturers with over 100 branch stores, is well known not only in Switzerland but also far beyond the national frontiers for the high quality of its products (see fig. 18). The very good reputation it enjoys is due above all to up-to-date factory equipment and scrupulously hygienic methods.

The seriously curtailed fuel quotas of recent times have made it no simple matter for the management of this concern to maintain their business in its previous volume while at the same time upholding at all costs their high standard of hygiene and their up-to-date methods. To fulfil these requirements meant that, in spite of fuel restrictions, the necessary heat and above all the hot water needed for cleaning and scouring had to be provided as before. The rational and modern equipment already installed left little margin for additional savings or for improved methods of heat utilisation. The only solution which remained to be considered was therefore the employment of electric current for heat generation; and here the choice lay between an electric boiler and a heat pump plant.

After thorough study of the whole problem, the progressively minded management determined to venture into new territory in the domain of heat generation and to install a modern heat pump as proposed to them by Sulzer Brothers, Winterthur. This decision was prompted above all by the desire, in the interests of national economy, to extract as much heat as possible from the none too abundant electrical energy available. How effectively this was done is indicated in the following paragraphs.

The problem set was to heat daily, from +10° C to +70° C, about 60,000 litres of fresh water drawn from the municipal mains, i. e. to produce some 3.6 million calories per day. The hot water was to be made available in the factory, particularly for cleaning and scouring purposes.



Looking down into the engine room of the M.S. "Säntis", which is propelled by two Sulzer two-stroke trunk-piston engines each developing 1200 B.H.P. The port engine is the one here visible.