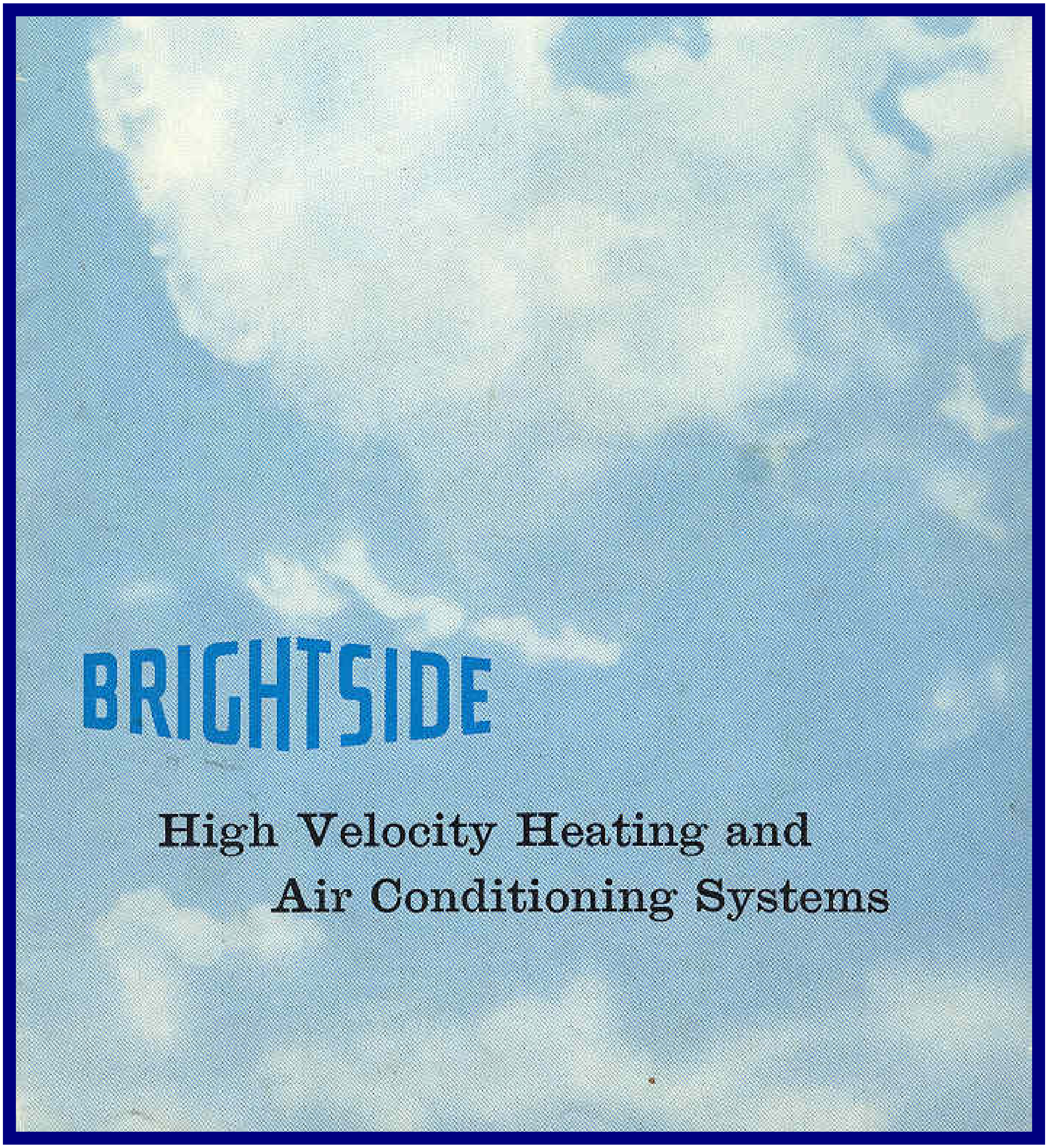


This booklet was written in 1961 by Brian Roberts, now Chairman of the CIBSE Heritage Group while he was Chief Air Conditioning Engineer of Brightside at a time when comfort air conditioning systems were beginning to be installed in the UK, the majority of installations up to that time being for industrial applications.

INTRODUCTION

Four types of system employing high velocity air distribution techniques are currently available. These are :

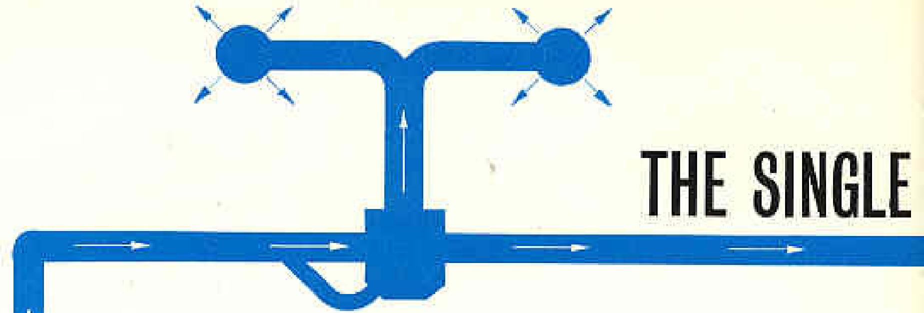
1. *The Single Duct All-Air System.*
2. *The Dual Duct All-Air System.*
3. *The Industrial All-Air System.*
4. *The Hi-Jet Induction System.*

The All-Air systems differ mainly in the type of high pressure air distribution terminal box employed. The Induction system makes use of both air and water in the Hi-Jet room unit.

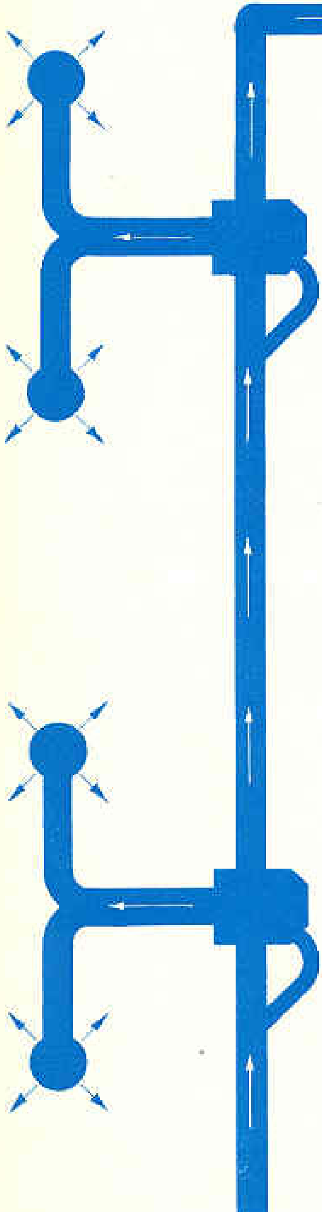
The various systems are sometimes thought to be competitive, but rather they should be considered complementary to one another as each has been designed and developed to meet the special needs of a particular application. Therefore, before selecting a high velocity system for a given building it is necessary to carefully consider many factors, for example : building size, arrangement and construction, usage, required temperature and humidity conditions, method of control and permissible limits, ventilation needs, space available for plant and ducts, initial and running costs, and many others.

Thus, the single duct system is well suited to small and medium sized buildings of conventional construction where fairly constant loads exist, and where ventilation allied with heating or cooling is required. The dual duct system is more flexible and can cope economically with fluctuating loads in medium and large buildings of normal construction. It may be used for both exterior and interior areas and is very suitable for applications requiring individual control and full air conditioning. So is the induction system. This is essentially a perimeter system for use in the exterior zones of large multi-storey buildings of modern lightweight construction having very large areas of glazing. The best arrangement is often a combination of two or more of these systems, especially in larger buildings such as hotels, office blocks and flats.

The three systems previously described are generally used for commercial applications, but the industrial high velocity system has been specially developed for use in factories, stores and similar buildings, and provides an efficient and economical method of air treatment.



THE SINGLE



A central air handling plant delivers conditioned air through a high velocity ducting system to attenuator distribution boxes located as required throughout the building. The system may provide winter heating and humidification, or summer cooling and dehumidification, combined with efficient filtration and silent draught-free ventilation.

APPLICATION

The high velocity single duct all-air system has been developed for use in small and medium sized buildings of conventional construction having moderate areas of glazing. Its most frequent application is in offices, shops and stores, small workshops and factories where effective ventilation and saving of space are essential, and where full winter heating and/or nominal summer cooling are required.

SYSTEM OPERATION

The single duct system is capable of providing winter heating and ventilation, summer ventilation by outside air, or nominal summer cooling and dehumidification. The single duct system is best suited to constant or slowly changing load conditions, especially when used for cooling applications, and is capable of maintaining comfortable temperature levels and a limited form of humidity control. It is generally necessary to vary the supply air quantity.

High velocity air is brought close to the required condition in the central plant before distribution to the various zones of the building. The condition of the air supplied to certain zones may then be modified by zone reheaters or recoolers before being conveyed at a high pressure to terminal boxes, for subsequent distribution at low pressure.

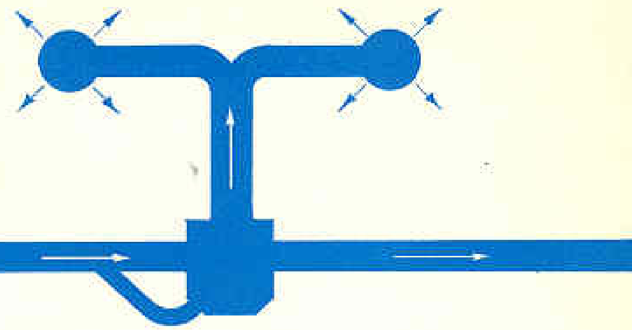
CONTROL

The supply air condition may be regulated in the central plant by a fully automatic control system responding to changes in internal load variations and external weather conditions as sensed by return air and outside controllers respectively. Zone control may be accomplished automatically by room or return air controlling elements regulating the output of zone heating or cooling equipment. Room control is effected manually by volume control of the supply air to a minimum ventilation rate.

SINGLE DUCT UNIT

This consists of a galvanised steel distribution box completely lined with sound absorbing material. High velocity air is supplied to a high pressure inlet, and is regulated by a special valve, usually a helical neoprene coated spring damper or a

DUCT ALL-AIR SYSTEM

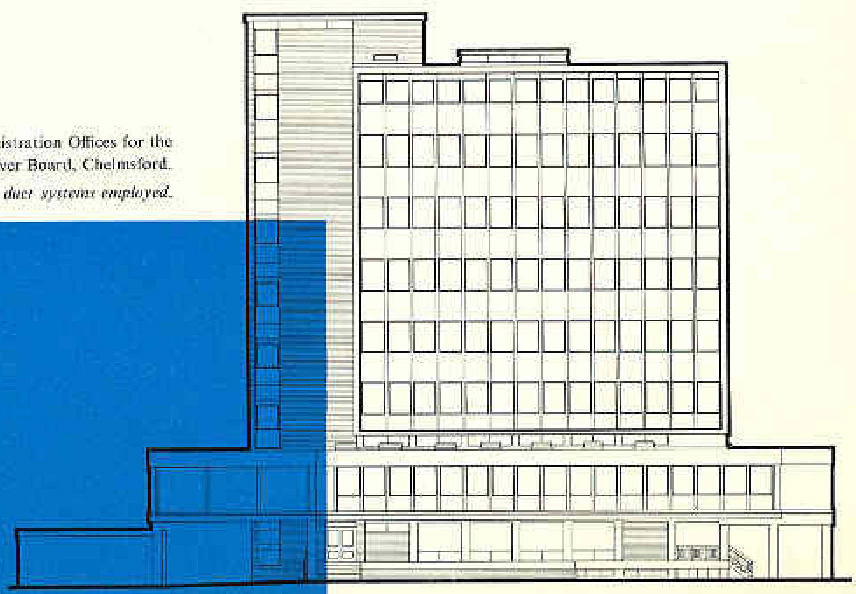


sealed neoprene bellows. With the spring damper unit, air volume may be varied by a remote wall mounted volume control or may be modulated by a room thermostat actuating an internally mounted air thruster motor. The bellows type of unit uses no motors or mechanical linkages and comprises a series of hollow vanes containing sealed bellows connected to control air. As air pressure is increased bellows inflate and vanes expand, constricting the free area and throttling the air flow. The bellows type of valve may be actuated by pneumatic thermostat or manual switch.

The unit is available as a ceiling diffuser model, or as an open end unit for supplying remote diffusers or grilles through low pressure ducting. Grille models supplying a directly connected grille or linear diffuser are available as ceiling, wall mounting or under-window units.

ADVANTAGES

- Considerable space savings over conventional systems.
- Relatively low initial cost.
- Zone control available.
- Low operating noise level.
- Adaptable to changes in internal building partitions.



Administration Offices for the Essex River Board, Chelmsford.
Single and dual duct systems employed.

Architects and Consulting Engineers:
E. R. Collister and Associates

THE DUAL DUCT ALL-AIR SYSTEM

English Electric House, Gaiety Site, London
Architects: Adams, Holden and Pearson
Consulting Engineers: Oscar, Faber and Partners

A central air conditioning plant delivers two streams of air at different temperature levels through high velocity ductwork to attenuator mixing boxes located as required throughout the building. The system may provide winter heating and humidification, summer cooling and dehumidification, or full air conditioning all year round, combined with silent draught free ventilation and efficient filtration.

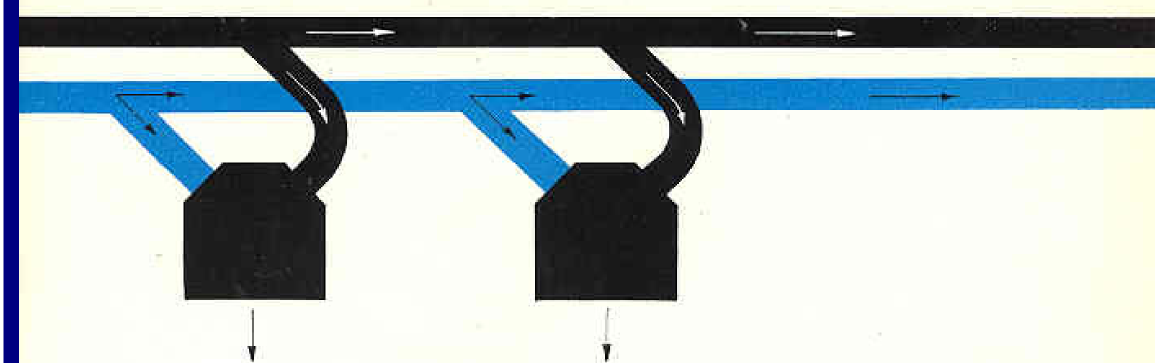
APPLICATION

The high velocity dual duct all-air system has been designed and developed for use in the perimeter areas of medium and large buildings having conventional structures with normal areas of glazing. Its most usual application is in office blocks, hotels, flats, schools, multiple stores and large shops. It is ideally suited also to interior zones of large buildings, public rooms, restaurants, bars and areas where effective ventilation and individual temperature control are required, and where saving of space is important.

SYSTEM OPERATION

The dual duct system is capable of meeting widely varying load conditions in separate areas both rapidly and economically. The dual duct system is extremely flexible in operation and is capable of maintaining accurate temperature conditions and comfortable humidity levels whilst providing constant air delivery.

High velocity air, at different temperature levels, is conveyed in twin ducts from the central plant to each distribution box. This ensures that a source of heating and cooling is available at each box, the air being mixed as required and supplied at low pressure to the various rooms. The air in the cold duct may be mechanically cooled or may be outside air for ventilation purposes.



CONTROL

The temperature levels in the twin supply ducts are regulated automatically according to outside weather conditions and changes in internal load. Under normal circumstances zoning is not required. Room control is usually accomplished automatically by a pneumatic system to maintain desired temperatures and constant air delivery by mixing the two supply air streams in correct proportions. With this system individual temperature control is provided to each room or area served by a mixing box.

DUAL DUCT UNIT

This consists of a galvanised steel distribution mixing box completely lined with sound absorbing materials. Two streams of high velocity air are supplied to high pressure inlets and are regulated by special valves operating in unison. These valves take the form of a helical spring damper or sealed neoprene bellows and operate as valves in single duct units, but mix high pressure air in correct proportions to offset the heating or cooling load of the space served. In the damper type units, air temperature is modulated by a room thermostat actuating an internal mounted air motor controlling the hot inlet.

A pressure regulator controls the cold inlet to maintain constant air delivery. The bellows type of valve may be actuated directly by thermostat, pressure regulator or manual switch.

The unit is available as a ceiling diffuser model, or as an open end unit for supplying remote diffusers or grilles through low pressure ducting. Ceiling, wall mounting or under-window units feeding directly connected grilles or linear diffusers are also available.

Laboratory in new office building for
Ley's Malleable Castings Co. Limited, Derby.
Architects: Morrison and Partners.

ADVANTAGES

- Considerable space savings over comparable conventional systems.
- Economical in operation.
- Individual room control available.
- Low operating noise level.
- Zoning not required except in exceptional cases.
- Flexible in operation with rapid response to load changes.
- Adaptable to changes in internal building partitions.

THE INDUSTRIAL ALL-AIR

A central air conditioning plant delivers conditioned air through a high velocity ducting system to high pressure silencing distribution terminal outlets. The system may provide winter heating and humidification, summer cooling and dehumidification, or year round air conditioning combined with efficient filtration and silent draught-free ventilation.

APPLICATION

The high velocity industrial system has been especially developed for use in the large open-plan, single storey building of lightweight structure with relatively small areas of glazing. Its most frequent application is in store-rooms, factories, workshops and similar types of building, where an economical method of air treatment is required, but where saving of space and reasonably accurate control of temperature are essential requirements.

SYSTEM OPERATION

The high velocity single duct all-air industrial system is capable of providing winter heating, ventilation, or air conditioning, but is limited to serving large open plan areas, or a small number of spaces with fairly similar loads. The system can maintain reasonably close temperature control and, if required, a certain measure of humidity control. The supply air volume is maintained constant, though the ventilation (outside) air quantity may be varied.

High velocity air is conditioned in a central plant and distributed through a high level ducting system to high pressure terminal units which take the form of a special distribution diffuser and may be equipped with attenuator sections where quietness in operation is of prime importance.

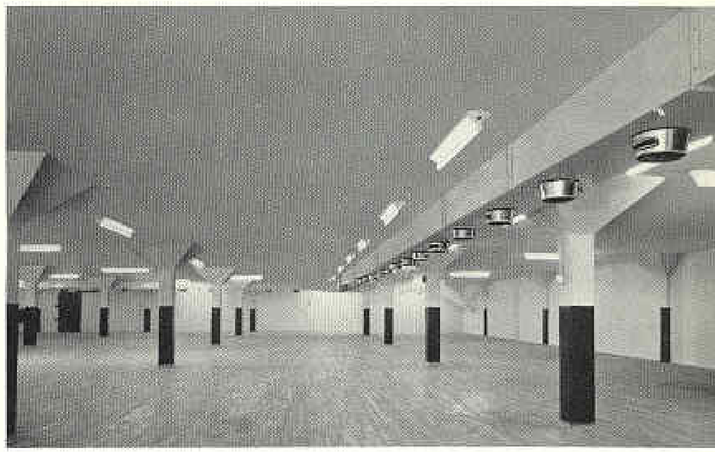
CONTROL

The supply air condition may be regulated in the central plant by a fully automatic control system responding to changes in internal load variations and external weather conditions. Individual areas with widely different loads may be served by separate zone reheaters or recoolers whose output is adjusted by zone controllers. The high velocity distribution terminals may be pre-set to deliver the required air quantities.

DISTRIBUTION UNITS

Two types are available. These are a slot model for exposed duct installations and a diffuser model for flush ceiling installation. The latter unit contains a plenum chamber and silencer section. Both models may be pre-set to give the required air quantities.

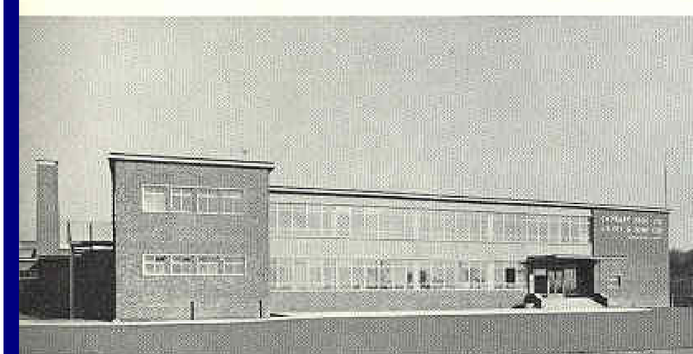
SYSTEM



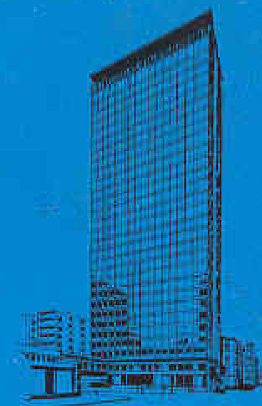
A chocolate storage depot at Ilkeston

ADVANTAGES

- Considerable space savings.
- Economical in operation.
- Low operating noise level if required.
- Provides ventilation and filtered air for industrial applications.
- Quick response to load variations.



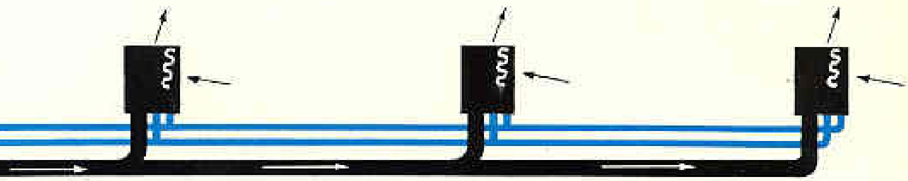
THE *Hi-jet* INDUCTION SYSTEM

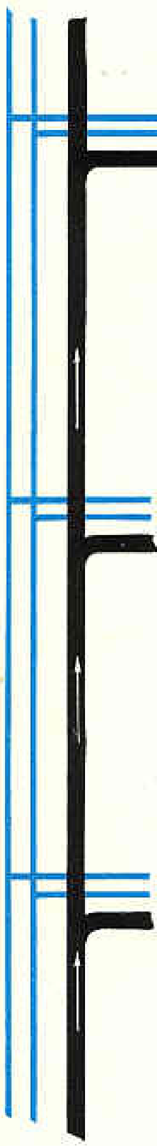


Concealed or free-standing units of under-window or high level ceiling type are available.

ADVANTAGES

- Considerable space savings.
- Economical in operation.
- Reduced fan horsepower.
- Individual room control available.
- Low operating noise level.
- Particularly suitable for modular building layouts.
- Adaptable to changes in internal building partitions.





A central air conditioning plant delivers conditioned ventilation air through high velocity ducting to room induction units which are supplied with water through a pipe circuit from a central source. The system may provide winter heating and humidification, summer cooling and dehumidification, or full year round air conditioning, combined with silent draught-free ventilation and efficient filtration.

APPLICATION

The high velocity Hi-Jet induction system has been designed and developed especially for use in the perimeter areas of large multi-room, multi-storey buildings having lightweight structures and large areas of glazing. Its most frequent application is in large office buildings, hotels, hospitals, schools, and blocks of flats, where the saving of floor area, simplicity of service and installation, and individual control of temperature and humidity in each room are essential requirements.

SYSTEM OPERATION

The Hi-Jet system is capable of maintaining desired room temperature and humidity independently under wide variations in sensible heat load, and accomplishes this by control of two elements—air and water. The first element is the *primary* air which is generally 100% outside air and is supplied to induction units in the various rooms through a system of high velocity ductwork. This primary air is filtered, cooled and dehumidified, or heated and humidified, according to season in a central plant and provides the necessary ventilation and also the motivating force for inducing (or recirculating) room air through to unit. The second element is the *secondary* water which is circulated to the coil in each room unit from a central plant and is supplied hot or cold according to season.

CONTROL

The building is divided into perimeter zones according to exposure and separate secondary water circuits are provided for each area. The primary air and the secondary water are automatically controlled in the central plant room, temperature of air and water being adjusted in accordance with prevailing load conditions. Individual adjustment of the output of each unit may be carried out by a manual or automatic water regulating valve, the latter actuated from room or zone controllers.

THE HI-JET UNIT

Each unit consists of a metal cabinet or builders work casing into which are fitted the basic components. These comprise an air silencing expansion chamber, water coils, primary air nozzles, recirculation and supply air grilles, and also filters if required.

The primary air duct is connected to the silencing chambers and the conditioned air passes through the induction nozzles into the casing of the unit. The high velocity air creates a reduced pressure area behind the water coil and induces room air through the recirculation grille and across the water coil, where it is heated or cooled. The unit output is regulated by controlling the rate of flow and temperature of the secondary water. The induction nozzles are specially designed so that the ratio of induced to primary air may be as high as seven to one, thus providing an adequate and effective air circulation rate in the conditioned area.

Branch Offices:—

BELFAST	36, Victoria Square Telephone 25592
BIRMINGHAM	17, Summer Row, 3 Telephone Central 5861
BRADFORD	40, North Parade Telephone 32531
BRISTOL	1, St. Nicholas Street, 1 Telephone 28454
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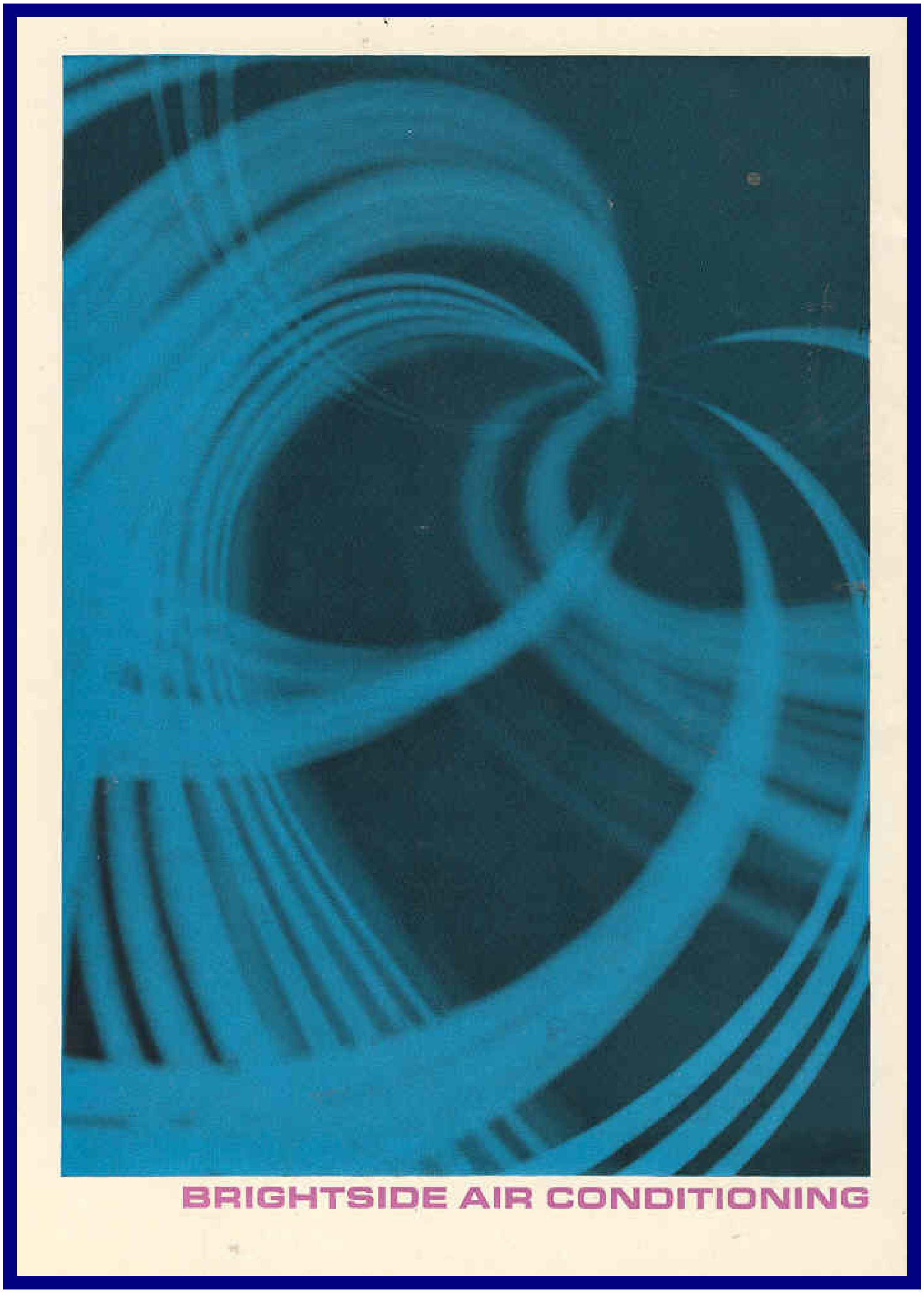
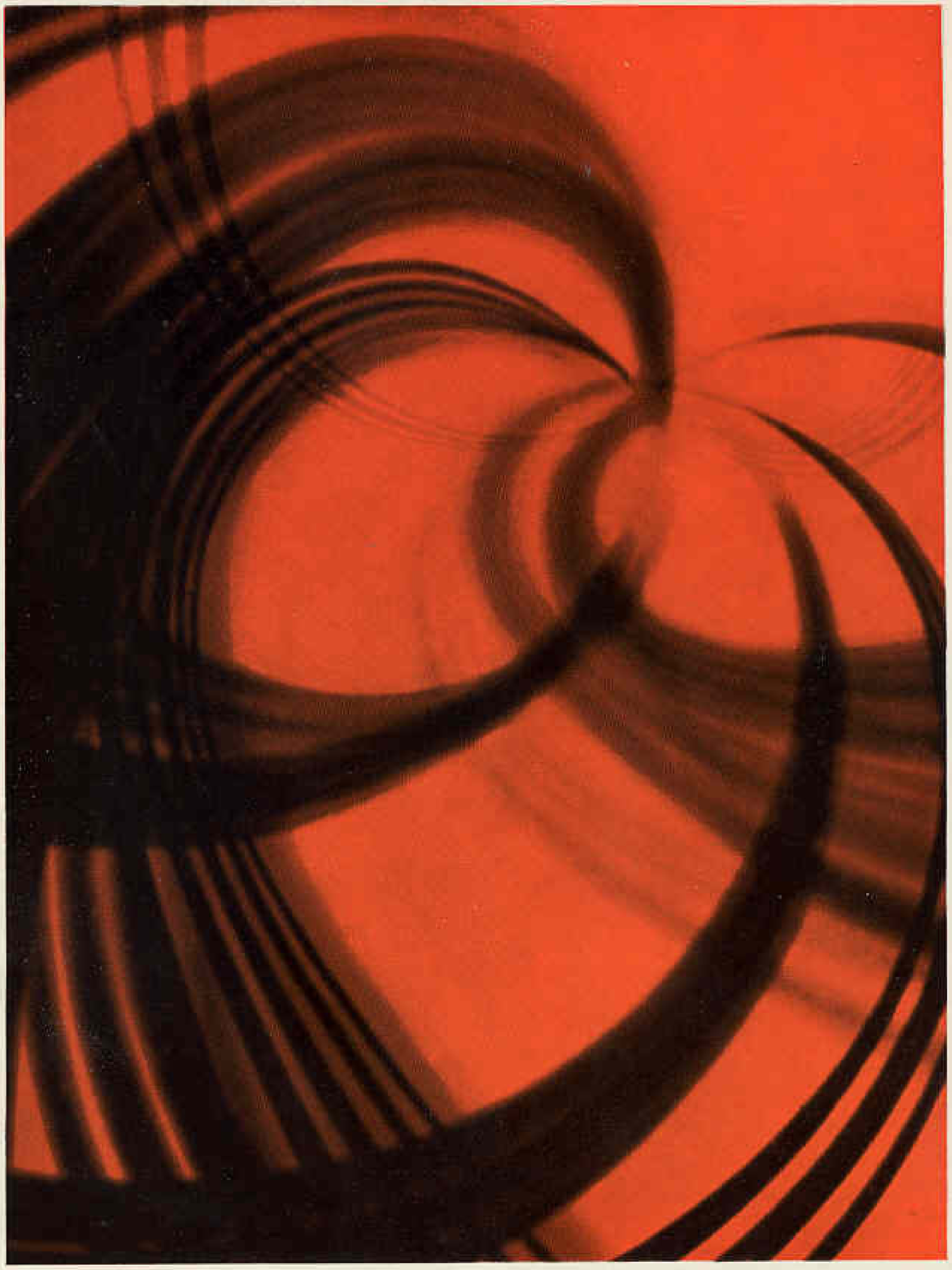
NEWCASTLE UPON TYNE	Lambton House, Lambton Road, 2 Telephone 81-3381
PORTSMOUTH	Anson Road, Milton Telephone 35337
SHEFFIELD	Don Road, 9 Telephone 42541

BRIGHTSIDE HEATING & ENGINEERING COMPANY LIMITED

G.P.O. BOX 118, SHEFFIELD 1. ***Telephone :*** **Ecclesfield 3121**

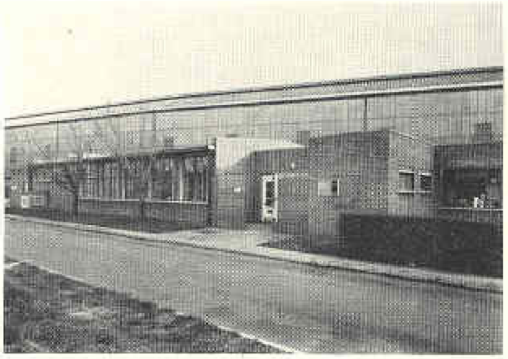
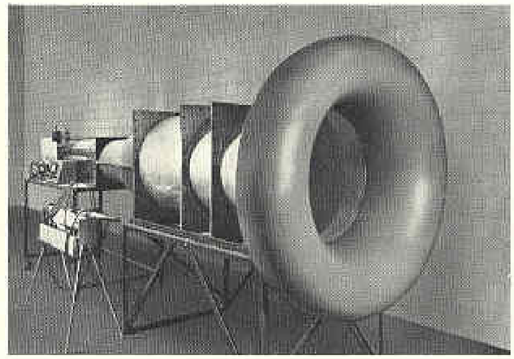


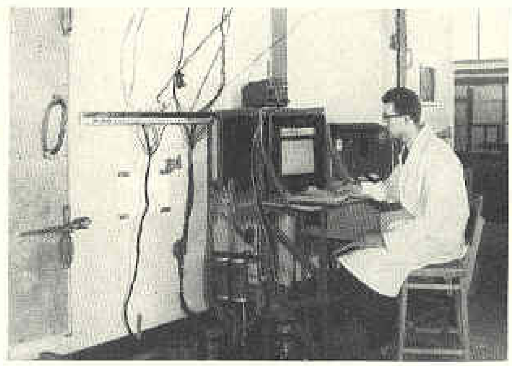
This booklet was written in 1965 by Brian Roberts, now Chairman of the CIBSE Heritage Group while he was Chief Air Conditioning Engineer of Brightside.



Section 1

Brightside Research Laboratories
What is air conditioning?
The economics of air conditioning

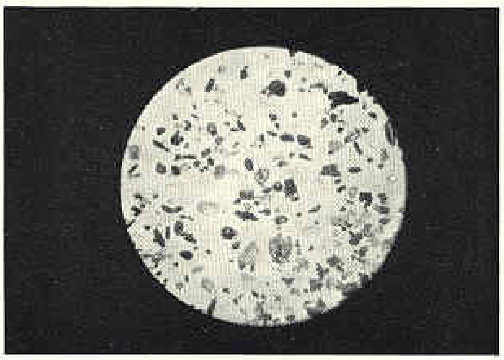


Brightside Research Laboratories

Brightside were the first to realise that the only way to bridge the gulf between fundamental research and its engineering applications was to establish their own applied-science research laboratory. From its beginnings in 1949 with a staff of two working in part of the Birmingham office, the laboratory has grown to its present status with its own building in Portsmouth. The laboratory is well instrumented and its equipment includes a large calorimeter room for appliance testing, steam and hot water generating units, and a wind tunnel.

The Company's central information section is also part of the laboratory. From here the Company is kept abreast of developments in world technology through the publication of Technical Abstracts, a bulletin written from a study of over 100 periodicals. The Research Department library maintains an extensive collection of technical and trade publications.

Atmospheric dust sampling apparatus.
The paper tape machine and its associated equipment is used by the laboratory for automatic recording of atmospheric dust concentration on site



Typical micro photograph of atmospheric dust from C.E.G.B. monograph "The Identification of atmospheric dust by use of the microscope."

What is air conditioning?

The term air conditioning originated in the cotton industry where the idea of producing the right moisture in the fibres by altering the hygrometric state of the air was first envisaged. Since then air conditioning has acquired increasingly broader connotations, and in engineering it has come to mean the control of all those parameters of the atmosphere that play a part in creating an optimum living environment. Thus the temperature of the air is involved as well as its moisture content and the amount of dust it contains. Turbulence - the degree of air movement - is another factor, and of course the air must be free from gaseous contaminants such as sulphur dioxide. To control these variables within prescribed limits at all times of the year needs all the engineering resources of modern air conditioning.

Refrigeration is necessary to cool the air in summer, and in many new buildings it is needed even in winter because of high sun gains through glazing or the heat given off from lighting and electrical equipment. In winter moisture needs to be added to the air and in summer it must be condensed out by the refrigerating plant. The atmospheric dust particles causing the most damage to the building and the people in it are those in the sub-microscopic range. These must be removed with high efficiency filters. Gaseous impurities need the special technique of adsorption for their removal.

Noise is another factor in the environment which air conditioning can help to control. In combination with fixed double-glazed windows it is the only solution to the increasingly serious problem of city traffic noise. The air conditioning system itself is designed to meet specific room noise criteria through the use of duct attenuators and vibration damping.

Air conditioning cost break-down

Building construction

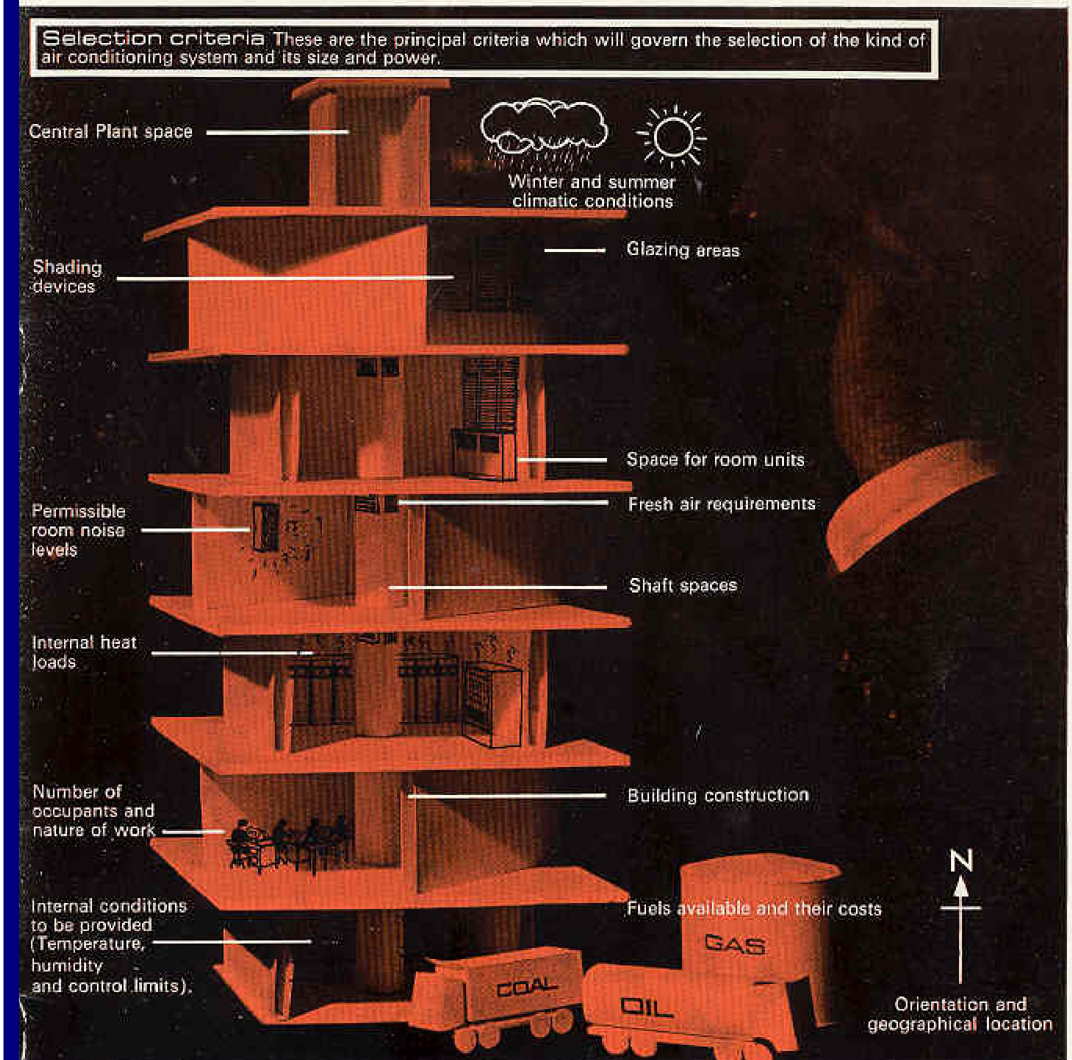
- Plant rooms
- Shafts
- Suspended ceilings
- Apertures
- Structural reinforcements
- Resilient suspension

Air conditioning plant

- Fans
- Filters
- Heaters
- Spray humidifiers
- Cooling coils
- Silencers
- Refrigerating Machinery
- Cooling towers
- Pumps
- Distribution ducts
- Thermal insulation
- Ceiling and wall diffusers
- Mixing boxes
- Induction units
- Pipework
- Electrical connections
- Control systems
- Instrumentation

Recurrent costs

- Fuel
- Water
- Electric power
- Spares
- Salaries
- Insurance
- Plant depreciation

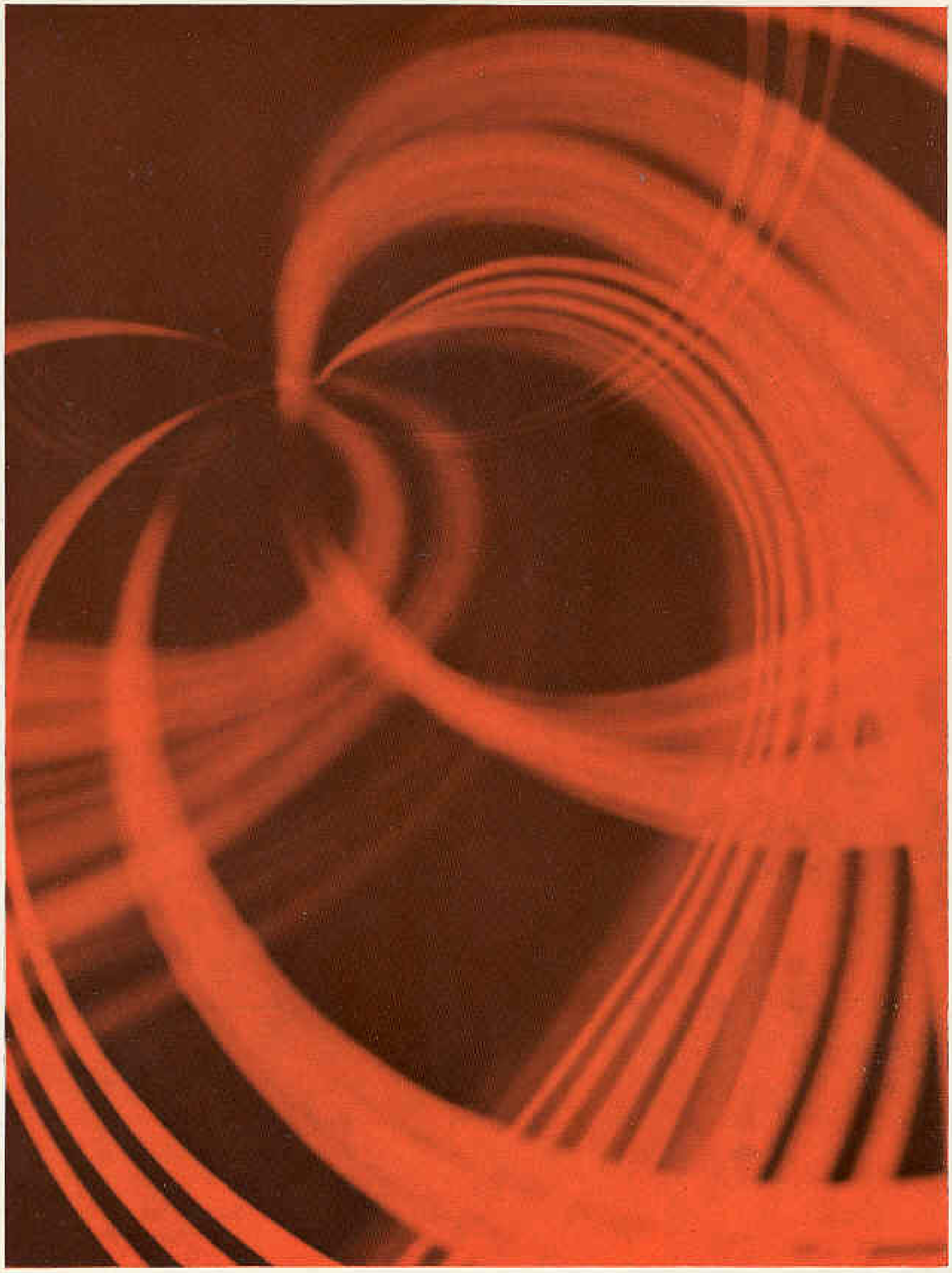


The economics of air conditioning

Any discussion of air conditioning economics must start with the building. Forethought in building design can make very appreciable savings in the installation and running costs of air conditioning. Glazing is the greatest single source of heat gain, and for every square foot of unshaded glass, up to £5 is added to the cost of the system.

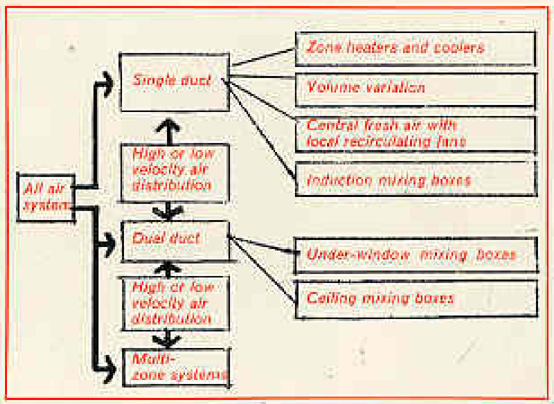
Good environmental engineering demands the following building requirements:

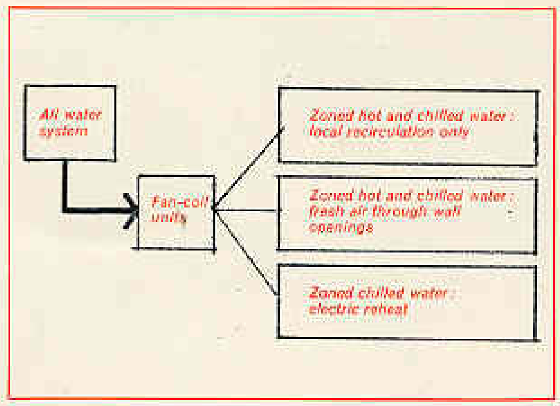
* Glazing should be reduced as far as is possible consistent with other considerations such as appearance, lighting and psychological aspects.
* Solar transmission through glazing should be reduced by using outside shading devices such as structural fins, internal blinds, or double glazing with the outer pane in heat-absorbing glass. Not only does this reduce refrigeration and air quantities, it also attenuates glare and the direct effect of the sun's radiation on the occupants.
* Insulation should be added to walls and ceilings: U-values in the region 0.20 to 0.25 are not difficult to achieve.
* Light coloured external surface finishes are desirable because these produce a high degree of solar heat reflection.
* High artificial lighting levels involve high heat output. The lighting criteria should be carefully examined in the project stage. Provision may be made for air extraction through light fittings into a ceiling plenum: this technique removes the high grade heat at its source.
* Outdoor air requirements should be limited to the accepted standards: air in excess of this only increases refrigeration plant size. The range of variation in air requirements for general office spaces for instance, is 0.15 to 0.35 $ft^3/min\ ft^2$ of floor area.

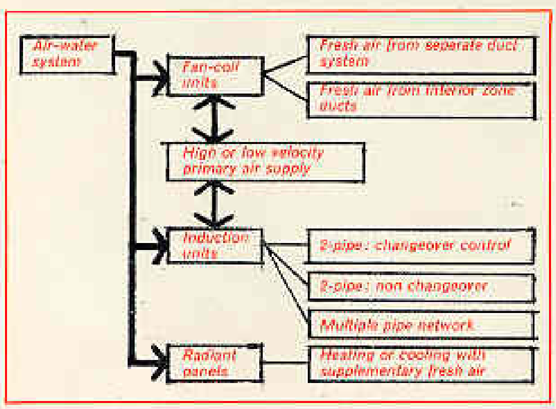


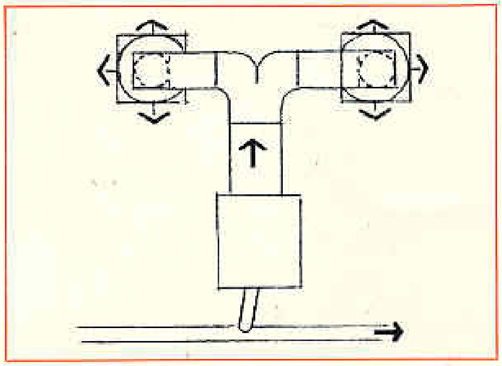
Section 2 / Air conditioning techniques

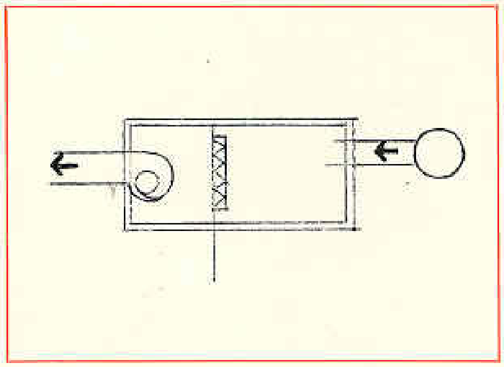
The various techniques of air conditioning fall into three generic groups □ these and their sub-divisions can be seen in the following diagrams

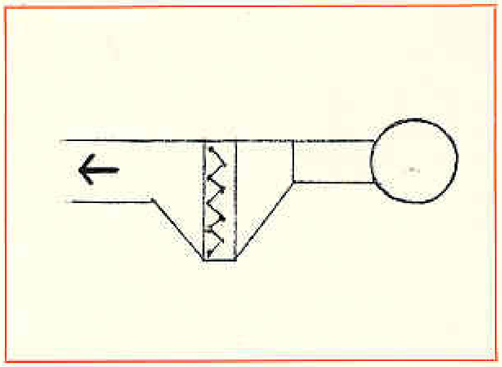












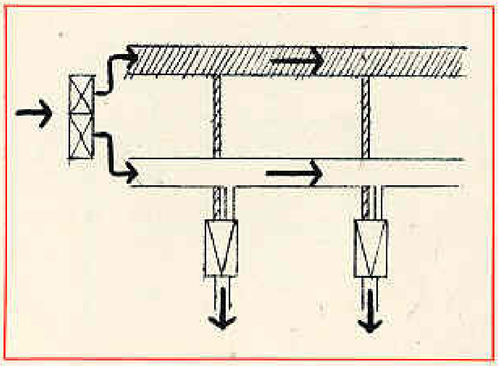
The single-duct system

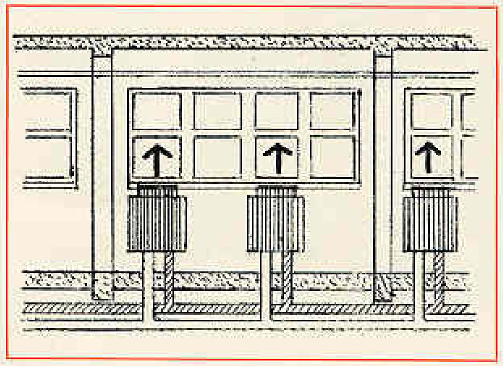
From the central plant room, a single duct is used to distribute the conditioned air. This means, of course, that all rooms receive air at the same temperature and moisture content. Thus in its simplest form the single-duct system must meet different room loads by supplying different quantities of air, e.g. sunlit rooms in summer need more cool air than those in the shade. When these loads fluctuate, however, room temperatures cannot be held steady. This objection is minimised either by the use of local heater and cooler batteries, or by automatically varying the air supply rate to meet the changing load. Individual rooms, or larger zones consisting of a number of rooms with similar heating or cooling requirements, can be treated in this way.

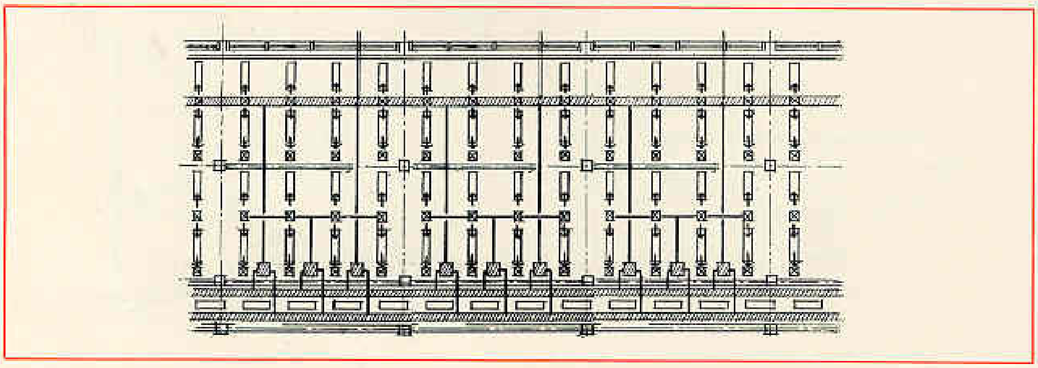
In its original conception the single-duct system employed air velocities of not more than 2000 ft/min, but later developments in acoustics, fan engineering and duct construction made it possible to extend this limit to about 5000 ft/min. The greatly reduced duct sizes saves in building space, and in large modern blocks with extensive duct networks the high velocity system is the solution most frequently adopted.

Low velocity distribution is still employed, of course, where space limitations are not critical, such as in industry.

In both systems either one central plant room or several multiple zone plant rooms can be used. The boiler plant and refrigerating machinery may be remote from these if necessary.







Dual-duct system

In this system the central plant room supplies air through two separate ducts running in parallel. The air in one is heated and in the other it is chilled. By mixing air from the two ducts any temperature between these limits can be obtained.

Connections are taken to special mixing boxes with motor-operated dampers which blend the two air streams together in the correct proportions according to the signal from the room thermostat. In this way every room if necessary can have its own independent temperature selection and the total air supply rate will remain substantially constant.

In practice the cold duct carries air some 20 to 25 degF lower than the room temperature, and in the heated duct the temperature is just above the room optimum. In winter, refrigeration is not normally needed for the cold duct, and the heated duct temperature is progressively raised as the outside temperature falls.

Room humidity can be kept within the comfort zone by the dual-duct system at all times.

The system of distribution generally takes the form of horizontal ducts in suspended ceilings with concealed mixing boxes and ceiling diffusers. In this way, no floor space is taken up.

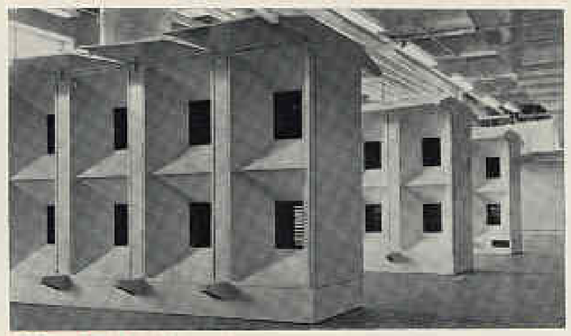
In cold climates where only single-glazed windows are used, some supplementary form of heat - such as skirting heating - is necessary along the building perimeter. Alternatively, under-window units can be placed at the building perimeter, the arrangement being fitted in with the building module.

Air for recirculation in the central plant can be taken by way of the building corridors into a few collection points on each floor of the building. The recirculated-air ducts normally run at low velocity.

The dual-duct system will satisfactorily handle fluctuating loads in both perimeter and internal zones. Control response is rapid and the system is flexible enough to permit changes in internal partitioning.

CONFECTIONERY STORAGE & DISTRIBUTION DEPOT, CADBURY BROS. LTD., ILKESTON.

This depot is served by a high velocity single duct warm air ventilation system having overhead distribution ducts and high pressure diffusers. This type of system provides an economical means of providing air treatment to large, open-plan areas.



MOGUL STACKING UNITS, CADBURY BROS. LTD., MORETON.

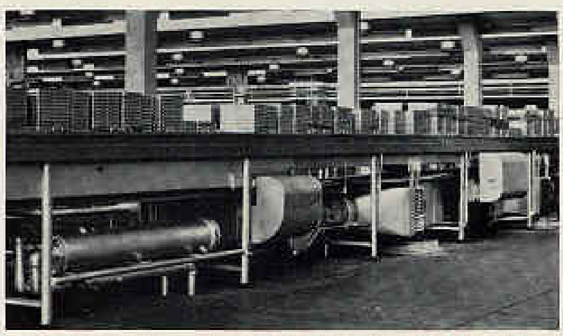
Located within a fully air conditioned space these stacking units are provided with an accelerated air treatment system to process part finished goods.

CLOSE CONTROLLED TEMPERATURE ROOM, CADBURY BROS. LTD., MORETON.

An air treatment system is provided to maintain the desired temperature within close tolerances throughout the treated space.

AIR CONDITIONING PLANT ROOM, ROWNTREE AND COMPANY LTD., YORK.

The refrigeration plant illustrated serves the 'Black Magic' packing room and comprises two reciprocating compressor units working with a matching evaporative condenser.



CONFECTIONERY PROCESS COOLER, CADBURY BROS. LTD., MORETON.

This process conveyor is conditioned by compact self-contained air conditioning plants to provide controlled conditions required during product manufacture. The conveyor itself is located within a fully air conditioned enclosure.

The confectionery industry

Air conditioning has become an essential part of the processes in confectionery manufacture. It has been shown to result in lower production costs with increased uniformity and quality of the product. Output has also increased by the improved productivity of the workers.

Storage depots in particular have benefitted from air conditioning in preventing deterioration of stock through temperature variations and disease.

By control of the environment at all stages of manufacture, it is possible to influence such processes as crystallisation and solidification so that the quality of the product can be guaranteed.

Some of the departments and processes which currently rely on air conditioning include raw commodity storage, hot and cold rooms, dipping rooms, cooling tunnels, coating kettles, enrobing, wrapping and packing, long-term storage, and short-term storage at the distribution depots.

CONFECTIONERY PACKING AREA, CADBURY BROS. LTD., MORETON.

A single duct high velocity air conditioning plant serves the area shown which is part of a 5 acre fully conditioned building. Duct sizes are kept to a minimum by employing air speeds up to 5000 ft/min and using special high pressure diffuser supply outlets.

CONFECTIONERY COLD STORE, CADBURY BROS. LTD., MORETON.

Air conditioning is provided to six confectionery storage areas, similar to the one illustrated, and comprises a low velocity duct system with direct expansion refrigeration plant with defrosting arrangements, giving controlled temperature and humidity conditions.

MODULAR OPERATING THEATRE AT HAMMERSMITH HOSPITAL FOR MEDICAL APPARATUS DIVISION OF HONEYWELL CONTROLS LTD.

The air conditioning provides 100% fresh air which is passed through prefilters and absolute filters, and heated, cooled, humidified or dehumidified as necessary to maintain desired conditions within the theatre.

BRITISH MILITARY HOSPITAL, DHEKELIA.

Brightside carried out the air conditioning installation and hot water services throughout the hospital including the provision of air conditioning for all operating theatres, radiography rooms, anaesthetic rooms, washing/scrubbing rooms and general operating suite areas. Additional plant was installed for a children's gastro-enteritis isolation ward.

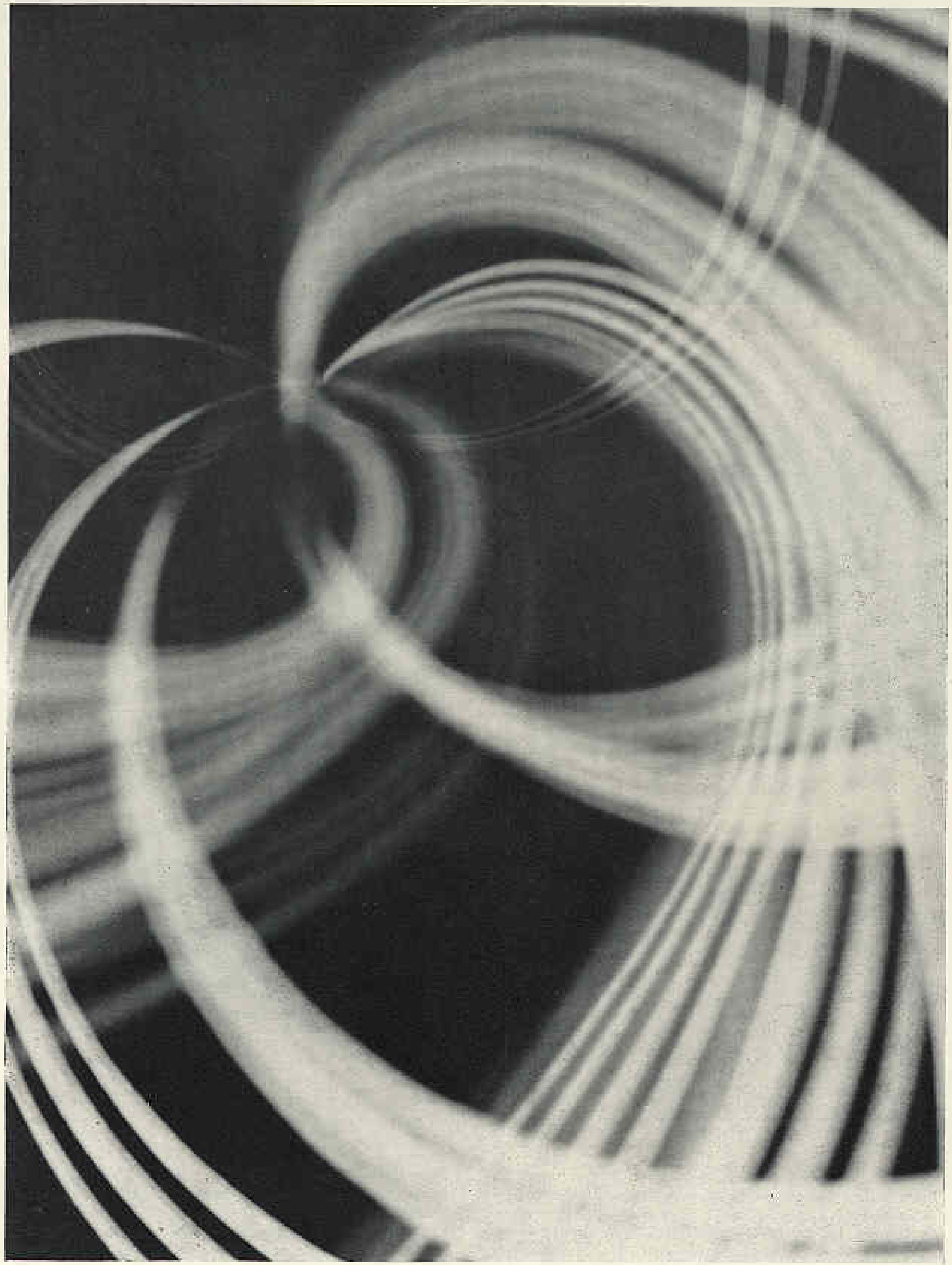
Consultants: E. Wingfield Bowles & Partners.

Hospitals and operating theatres

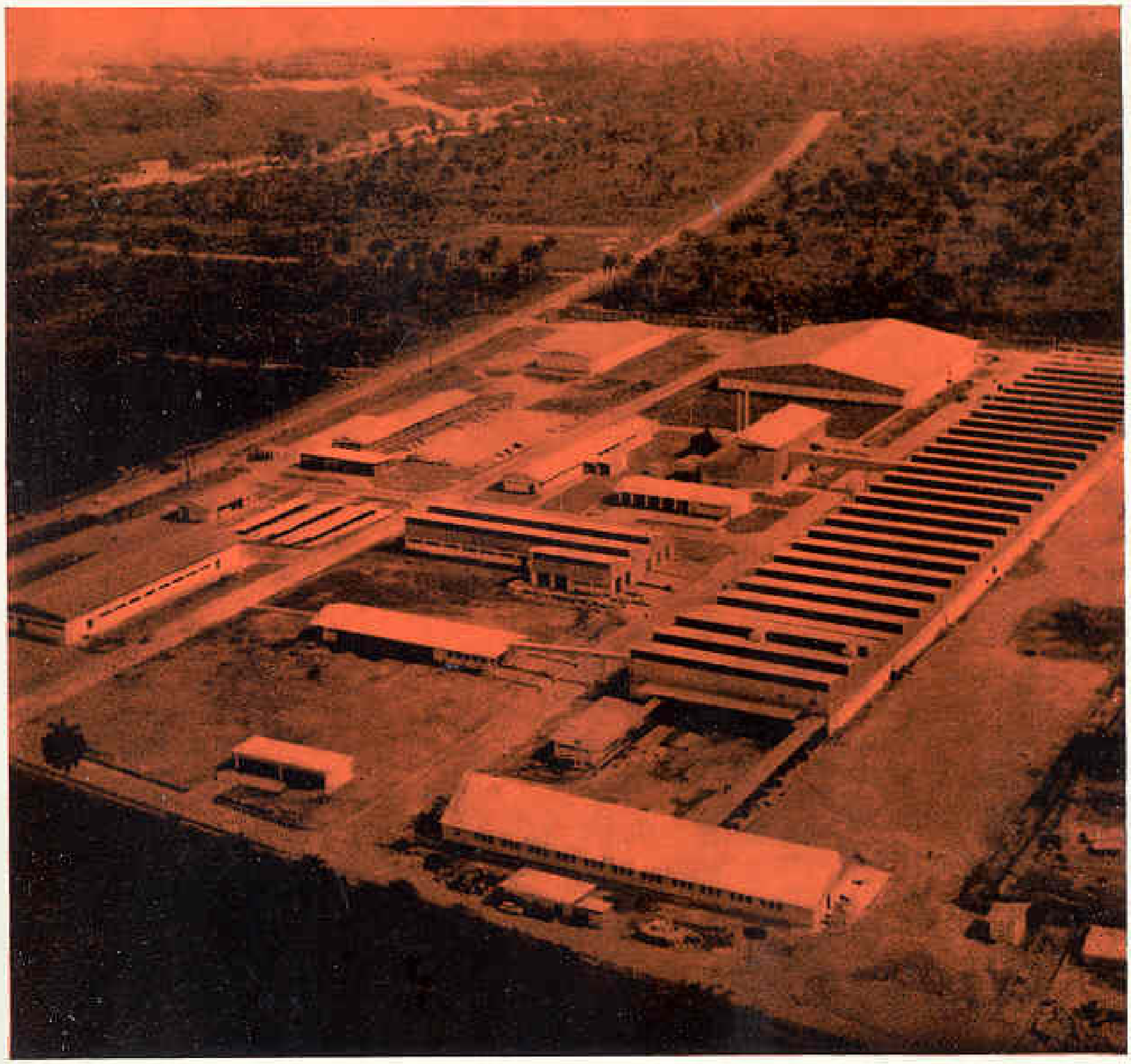
Airborne infection is the greatest single cause of transmitted disease in hospitals. Thus the air conditioning plant must be designed to control the pattern of air distribution as well as its purity. Normally, no air is recirculated and independent plants are used for the various departments. The benefit to patients of an atmosphere which is always within the comfort zone has been shown to be considerable.

The operating theatre is a special case in hospital air conditioning, requiring as it does stringent control of air purity and air flow. Heat given off by the surgical team and equipment can give rise to intolerable conditions in summer and experience has confirmed the very great benefits of cooling the theatre by the air conditioning plant.

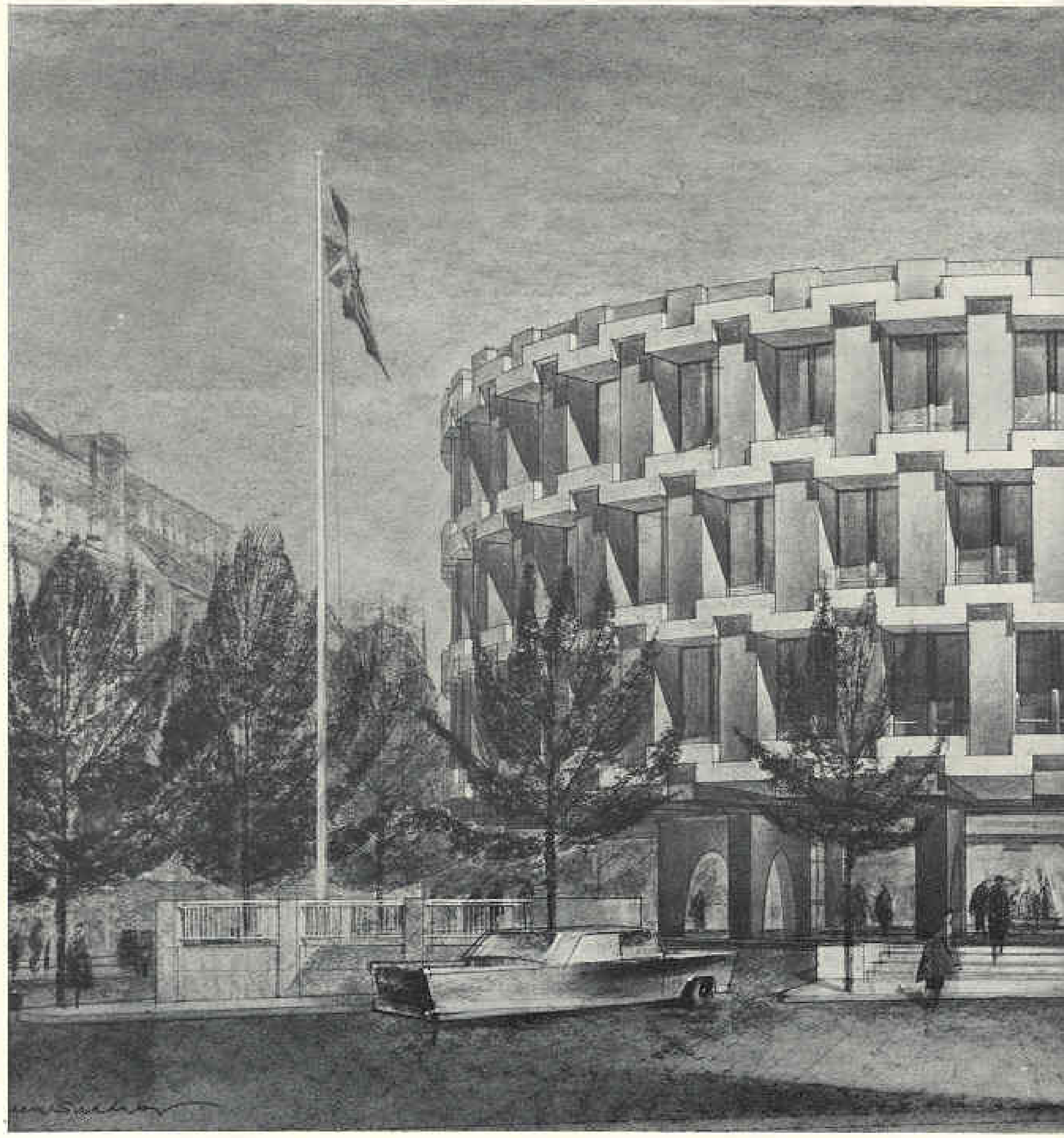
A recent development in operating theatres has been the so-called 'modular' theatre: this is a complete assembly which can be erected independently of the building structure; it contains all the surgical and engineering equipment needed including the air supply system and refrigeration plant. An advantage of the modular theatre is its ability to meet changes in hospital organisation and advances in surgical techniques.



Section 4 / Overseas installations



MICHELIN (NIGERIA) LTD., PORT HARCOURT, NIGERIA.
Services provided by Brightside include air conditioning, ventilation, compressed air, process refrigeration plant, and all piping services throughout the factory.
The refrigeration plant consists of two centrifugal machines with a total capacity of 880 tons of refrigeration. Condenser cooling water was piped through 2½ miles of jungle in 24 in and 16 in diameter tubing.
Consultants: Michelin Tyre Co. Ltd., Stoke-on-Trent.

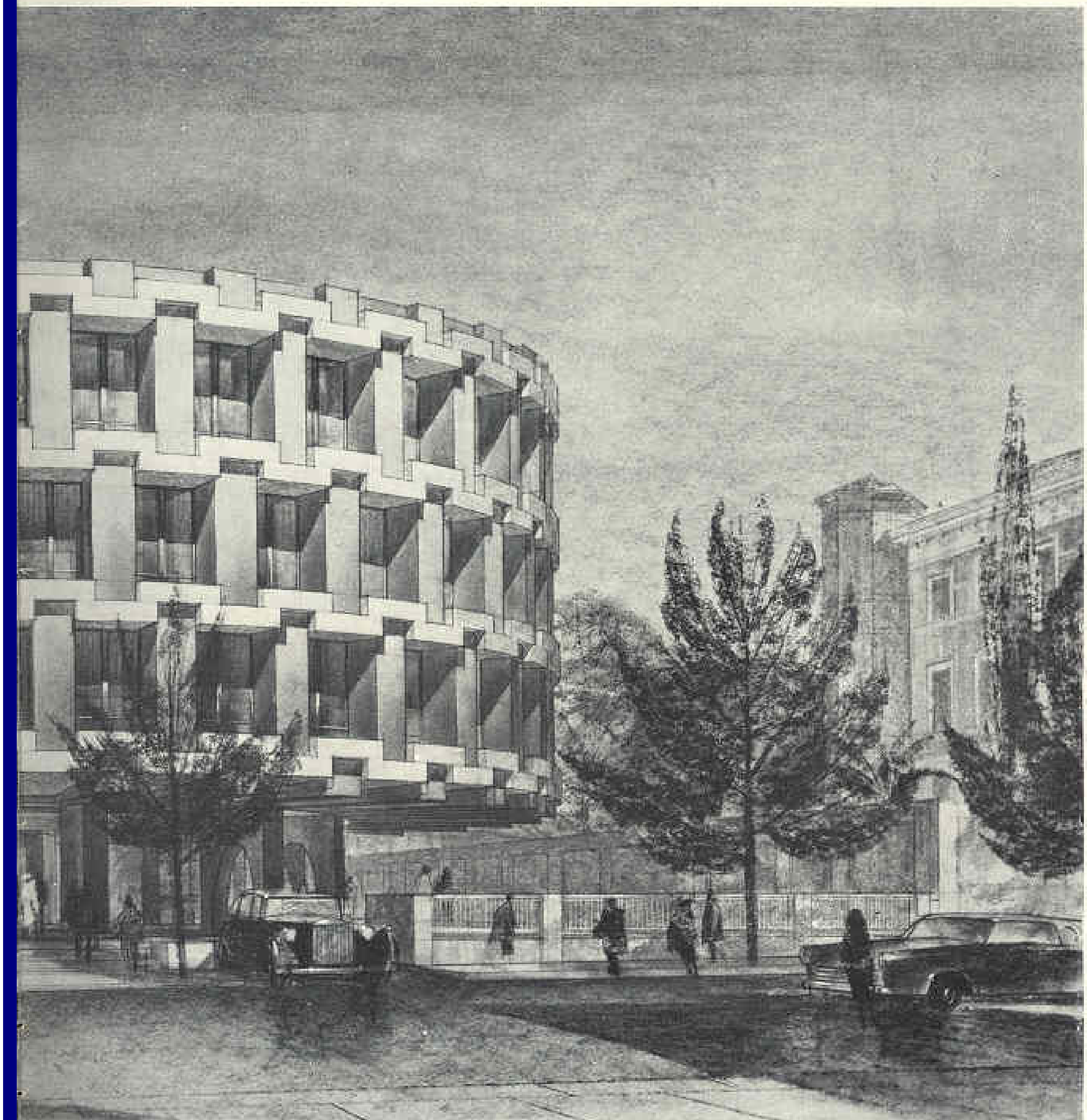


HER BRITANNIC MAJESTY'S EMBASSY, MADRID

This new office building is fully air conditioned by a high velocity induction system using high level concealed units with individual thermostatic control. The main plant comprises two packaged water chillers with total capacity of 100 tons, and two oil-fired packaged boilers. Other services provided include extract ventilation, compressed air lines for controls, electric wiring and electric panel heating.

Architects & Consultants: W. S. Bryant, M.B.E., A.R.I.B.A. Assistant Chief Architect. M O P B W London in conjunction with Blanco Soler of Madrid.

Main Contractor: Laing Iberia, S.A.



LITTLE ADEN CANTONMENT

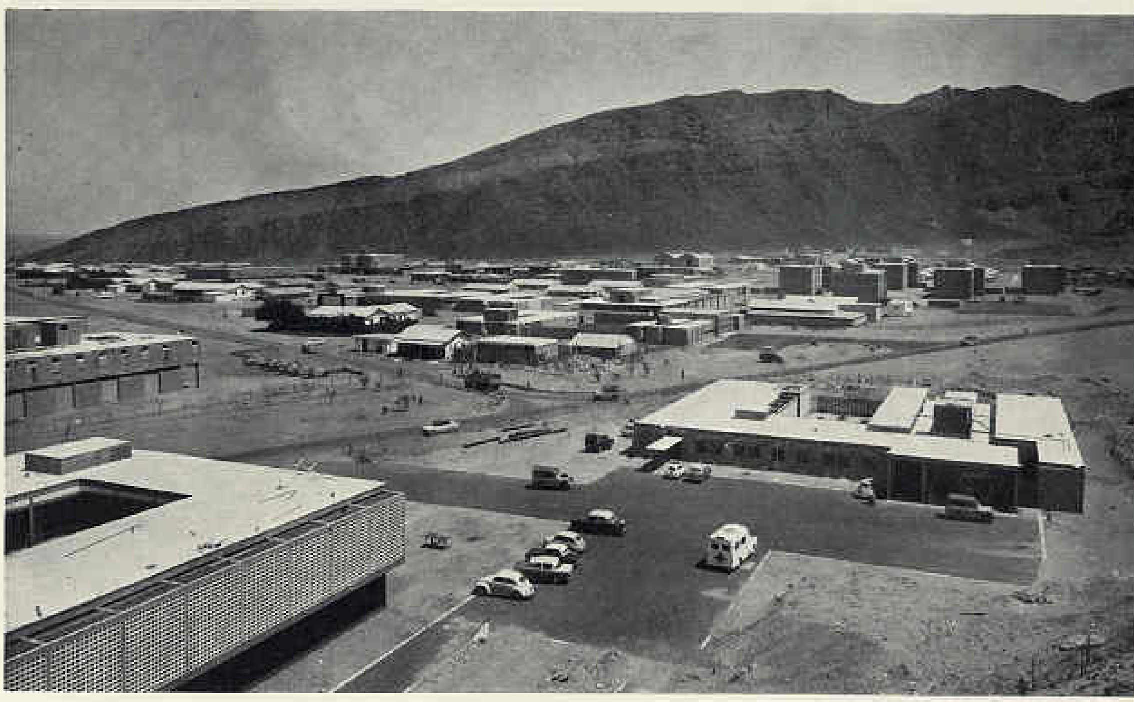
In the new British Army Cantonment at Little Aden, Brightside installed the whole of the air conditioning and mechanical services throughout the various types of buildings including administration offices, workshops, accommodation, messes, shops, medical centre, school, fire station and telephone exchange.

110 separate air conditioning plants were installed in individual buildings having a combined cooling capacity of 1750 tons refrigeration.

A feature of the installation is the wide scale use of plastic materials. Internal ductwork is fabricated from double-skinned P V C ductwork, with polystyrene insulation between. All chilled water pipework is run in P V C tubing throughout the site area.

The types of air conditioning range from residential systems to high velocity induction plant. Other works include ventilation, kitchen hoods, hot water services and butane gas services.

Architects: Farmer and Dark for M P B W
Consultants: Brandt and O'Dell



EASTERN BANK LTD., ABU-DHABI.

This building in the Trucial States is fully air conditioned, a feature of the design being the use of a ventilating ceiling for the office areas since this was found to be a very attractive and economical solution to the problems of air distribution. Brightside also undertook all refrigeration and pipework services as well as plumbing and electrical work.

Architects: Tripe & Wakeham.

SOUTHWELL HOSPITAL, AHMADI, KUWAIT.

Built for the Kuwait Oil Company Limited, the hospital covers approximately 40 acres and has beds for 200 patients distributed among eight ward blocks. The hospital is fully conditioned throughout with heating and cooling media piped from a central equipment room to local air handling plants. The refrigeration plant comprises two centrifugal water chillers of 700 tons total capacity Brightside were responsible for the installation of all mechanical and electrical services including steam boiler plant (arranged for either natural gas or fuel oil firing), pipework for steam, water and medical gases, message tubes, central vacuum cleaning plant, electric power, lighting lifts, fire detection and staff location systems.

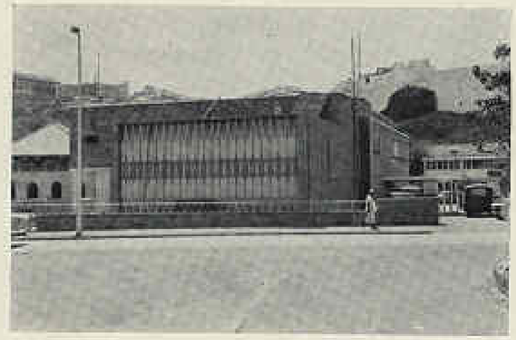
Architects & Consultants: Huckle & Durkin.

Main Contractor: Contracting & Trading Co., Kuwait.

MATERNITY HOSPITAL, STEAMER POINT, ADEN.

Operating theatres and delivery rooms are conditioned by a 100% fresh air plant with humidity control. Ward areas and corridors are conditioned by self-contained units conditioners with overhead distribution.

Consultants: Brandt & O'Dell.



BRITISH FORCES BROADCASTING STATION, STEAMER POINT, ADEN.

Studios and administration areas are air conditioned by a central plant with zone coolers. The refrigeration plant employs the direct expansion system with three compressors and matching evaporative condensers. An electronic control system is provided.

EDUCATION CENTRE, KHORMAKSAR CAMP, ADEN.

Air conditioning is provided by a system of high level fan-coil units served with chilled water and ventilation air from a central plant. A packaged chilled water set works in conjunction with a cooling tower. Each classroom is provided with individual thermostatic control.

Consultants: Brandt & O'Dell.

CABLE & WIRELESS LTD. RECEIVER STATION, SALT PANS, ADEN.

Packaged air cooled refrigeration air handling units supply conditioned air to communication bays; and administrative offices. The associated transmitting station in this area was also conditioned by Brightside using a similar type of system.

Architects: Cable & Wireless Architects Dept.

BRIGHTSIDE HEATING & ENGINEERING CO. LIMITED

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Edinburgh *5 Albany Street*
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Glasgow *6 Lynedoch Crescent*
Telephone: Douglas 3971

Liverpool *242 Upper Parliament Street*
Telephone: Royal 3816

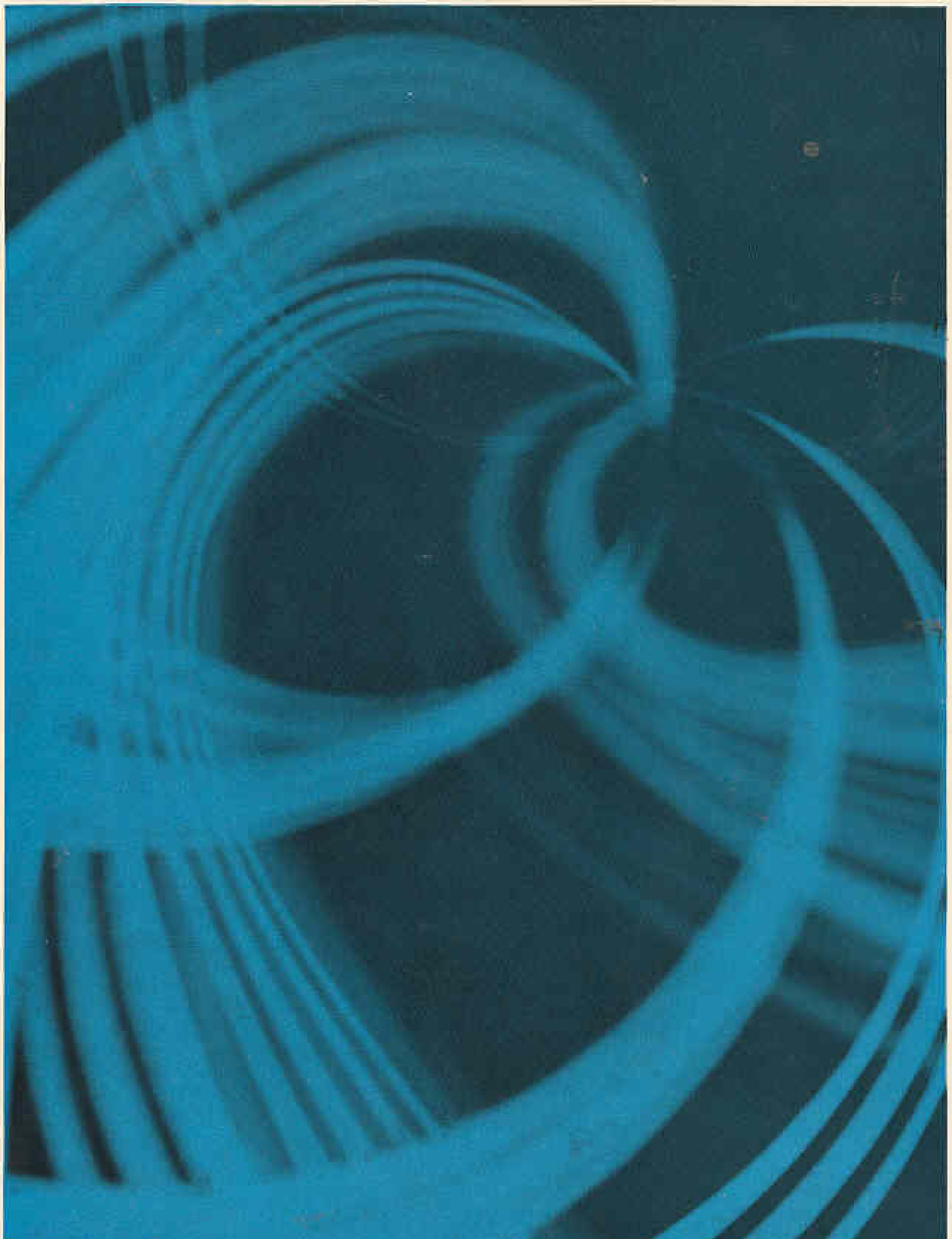
London *Vincent House, Vincent Square*
Telephone: Tate Gallery 8721

Manchester *105 Princess Street*
Telephone: Central 4377

Newcastle-Upon-Tyne *Lambton House, Lambton Road*
Telephone: 81-3381

Sheffield *Don Road*
Telephone: 42541

Research & Development Laboratories
Portsmouth *Anson Road, Milton*
Telephone: 35337



BRIGHTSIDE AIR CONDITIONING