HOSPITAL STEAM ENGINES IN THE BRISTOL REGION

by John Sawtell

The use of reciprocating steam engines to generate electricity dates, for public supply at least, from the Porter-Allen horizontals at the Holborn Viaduct power station which commenced work in January 1882. It is an application in which the steam engine has survived in some numbers where there is an industrial or institutional requirement for both electricity and process steam. To be able to meet all or part of the electrical demand as a by-product of steam produced for heating purposes - in effect using the engines as pressure reducers - has obvious economic advantages. As a result, many such plants were set up, in some instances the engine being also employed as a prime mover.

One of the earliest sets to survive from the institutional application is an 1895 Willans engine direct coupled to a dynamo by F.M.Newton of Taunton, from the Herrison Hospital, Dorchester, and now stored in the Science Museum, London. Longevity is a feature of this type of equipment: 1905 Belliss & Morcom engines are still at work seven days a week, having long since acquired the condition their makers describe as "engine dead quiet, no sound audible when standing close by." This Birmingham firm dates from 1852 and by 1866 as G.E.Belliss & Co., it was developing its proprietor's idea of improving the power weight ratio of the steam engine by increasing its rate of revolution. This machinery rapidly found favour with steam launch builders and later was used in small naval vessels. An indirect result of this latter use was that Alfred Morcom joined the company followed by - as chief draughtsman - Albert Pain. In 1891 the first quick revolution engine utilizing his forced lubrication system and the valveless oscillating oil pump was built. At the turn of the century Belliss & Morcom was formed and development of a whole range of standard vertical totally enclosed engines, singles, compound and triple expansion, meeting every need, continued. The company, like the other firm represented in the Bristol area, W.H.Allen Sons & Co. Ltd., of Bedford, better known perhaps for their turbines and pumping equipment, are now part of Amalgamated‘ Power Engineering.

All the plant in the Bristol area is of the back pressure type, exhausting. not to atmosphere or vacuum but into a process steam main. It is certainly not remarkable for its great antiquity, rather, perhaps, the reverse. There is, however, a certain variety of engines and equipment, boilers and until recently fuel. The earliest plant was installed in 1923 at St. Monica Home of Rest, at the northern extremity of the Downs, which formed an interesting comparison with the not dissimilar station of fourteen years later at Barrow Gurney. The earliest survivor is the little S type Belliss & Morcom in the basement of the Homeopathic Hospital in Cotham Hill, which was part of a heating rather than primarily a power supply system. At Glenside a vertical twin cylinder shares a basement with a more usual compound set while at Winford Orthopaedic the generators of 1960 are not close coupled but belt driven. Some years ago a migratory Bellis & Morcom arrived at Stoke Park for use on a standby generator but, apparently, was never erected.

Lancashires are in use at all the sites except Barrow, which has three Economic boilers. Both here and at Glenside Coal Tar Fuel supplied by Bristol and West Tar Distillers, was used for a number of years ending in April 1969. With changes in demand for some of the other products obtained from crude tar production of this has now virtually ceased. As a fuel it had some advantages, besides the initial one of cost, particularly a low 1 per cent sulphur content reducing, should flue temperatures fall, the production of sulphurous acid and attendant corrosion.

ST. MONICA. 156/ST 572763 - Financed by H.H. and Dame Monica Wills as a home for one hundred invalid "gentlefolk" ladies and designed by Sir George Oatley. His splendid neo-Tudor extends to the boiler and engine rooms which lie beneath the castellated tower which contains water tanks and conceals the chimney shaft. The engines, Belliss & Morcom C4 compounds, 6875, 6876, 6877, direct coupled to English Electric, Bradford, dynamos were broken up by John Cashmore of Newport in January 1969. The engine room is now a workshop and mess room, while the old battery room serves as a sub station for the national grid supply. The concrete bed for the three sets was an example of the detailed planning and construction of the home. Not only was it independent of the rest of the structure but was itself resiliently mounted on a three inch pad of cork. Some settlement resulted from this, the heavy ends of the sets sinking an inch without ill effect, the dynamos eventually following suit. Obviously vibration in a home of this type could pose very real nuisance problems and the elaborate measures taken may well have been

The three wire DC system was rectified by a Booster Balancer set by the Electric Construction Company, Wolverhampton - this and the MEM switchgear was also installed in the engine room. The sets - which had a 20 per cent overload capacity - met all the electrical requirements of the home, one set (a pair in winter) working alternate days from 06.00 until 22.00, the night load then being taken over by 180 cells of 1,500 ampere hour capacity. Around 1958 mercury arc-rectifiers were installed and the supply augmented from the grid, the batteries being dispensed with.

During 1968 the home was rewired throughout for alternating current and now of the forty five years of generation only a pair of Bellies & Morcom oil filter tanks remain. Steam at 140 psi was provided by two Thompson, Wolverhampton, Lancashire boilers, feed water being collected from the roof of the home and stored in a 50,000 gallon tank. Firing was by hand from top filled bunkers until the boilers were phased out of service in 1968 and replaced by two GWB oil fired packaged boilers. Back pressure steam at 3/5 psi was fed to calorifiers to provide domestic and heating hot water, returning for boiler feed. A separate and longer steam main at a reduced pressure of 40 psi supplied a number of air heaters and other needs, another at 70 psi fed the laundry.

HOMOEOPATHIC. 156/ST 581737 - A one hundred bed hospital established in 1852, the present buildings were erected in the 1920's. In the basement one of a pair of Belliss & Morcom single cylinder S4 engines (7061) direct coupled to a Metropolitan Vickers Electrical Company “DC generator" remains. These dated from c. 1923 being installed to provide current for three Laurence Scott and Electromotors motors driving the fans of the ducted hot air system, their back pressure steam at 5 psi providing the air heating medium - a combined system which allowed the heating to be controlled by the speed of the engine. The sets last worked in 1967 when the 1 second engine was removed and a rectifier installed to provide power for the fans, the other engine remaining as standby. Currently steam at 90/100 psi is provided by two Lancashire boilers oil fired by Hamworthy equipment for domestic and radiator heating calorifiers. The chimney shaft which passes through the centre of the building must provide a certain amount of supplementary heating !

WINFORD 156/ST 537656 - Built 1928-30 by the Bristol Crippled Childrens Society as a childrens orthopaedic hospital of twenty beds, it now has 230 adult and children beds - plus its own school. Sir George Oatley was the architect and the engine, boiler room and workshops are contained in a neat single storey building with an uncompromising square brick chimney shaft, on the opposite side of the road to the main building. The engines are Belliss & Morcom C4 compounds, "Number 1" being 8967, dating from 1935 and "Number 2", 8313 from 1929 and driven from them by Fenner 'Spacesaver" V belting are Lancashire Dynamo and Crypto alternators. The pulleys for this drive - which raises the engine speed of 600 rpm to 1,500 rpm - are mounted on the shafts of the original direct coupled DC generating equipment. This was rated at 50 kW at 600 rpm plus 10 per cent overload, the present equipment, which dates from 1960, is rated at 52 kW AC and one set is in use full time, on monthly turns, in parallel with the grid from October to April. During summer a set is kept ready for emergency demand. The switchboard is by Lancashire Dynamo Nevelin, Oxted, Surrey. Prior to the war the site was entirely DC serviced, with battery storage. During and after this period grid supplies were introduced, but it was not until 1960 that the change-over was complete.

Two Lancashire boilers by Edwin Danks of Oldbury, 6560 of 1929 and 6653 of 1930 provide steam at 50 psi. Back pressure, or pressure reducing valve, steam at 8 psi is passed to four heating and four domestic calorifiers, returning for boiler feed. September 1961 saw oil firing - equipment by H. Saacke Ltd., Portsmouth - take over from Somerset coal while in the previous year an economiser by Greens of Wakefield had been provided pre-heating feed water up to 100°F.

BARROW 156/ST 537687 - In 1930 Bristol Corporation acquired 260 acres of the Wild Country at Barrow Gurney as a site for the hospital and it was opened on 3 May 1939. Sir George Oatley was architect and Oscar Faber, OBE, consulting engineer. During the war it was requisitioned as a naval hospital and today it offers some 400 beds, well short of the figure originally intended. The power station plant was ordered in October 1936 from W.H.Allen of Bedford and installed by G.N.Haden & Sons Ltd. All three engines are equipped with automatic expansion gear, the smaller - 40 kw - unit being rated at 60 bhp with 10 per cent overload capacity for two hours, the 80 kw pair at 120 bhp with 20 per cent overload capacity for two hours. A feature of the Allen engine is that each cylinder has its own valve, their rods being connected to a crosshead, within the engine trunk, actuated by the single eccentric. During the summer the smaller set is in constant use, in winter one of the 80 kw sets works monthly turns. GEC supplied the two balancer sets for the three wire DC system and also the switchboard - a black array relieved by porcelain and brass. National Grid supplies were introduced by the navy who put in the Electric Construction Company mercury arc rectifier and AC supply now meets most of the needs on the site apart from the kitchens and workshops.

Three Sinuflo Economic - return with uptake at front end - boilers by Cochran of Annan, K.3098, K.485

(1937) and K.482 (1937) produce steam at 200 psi. Originally Hodgkinson automatic stoking equipment was fitted but in 1955 Clyde fuel systems provided pumps, heaters and burners to deal with CTF 200. Since 1 April 1969 heavy fuel oil has been used. On the roof of the boiler house and adjacent to the short metal chimney is a Senior, London, "H" type Economiser. Exhaust steam at 15-20 psi back pressure feeds two domestic and two heating calorifiers, the latter supply overhead radiator ceiling panels in the wards. The future of the generating equipment is uncertain and it appears likely that the existing dynamos will be replaced with alternators to work in parallel with the grid or else the whole load will be taken from this source, with a diesel set as standby.

GLENSIDE 156/ST 625764 - A one thousand bed hospital opened in 1861 as the premier mental instit~ ution of Bristol Corporation, this is an unusual site as its first generating set was installed only just over ten years ago. At that time the hospitals demand for electricity was rising and by installing a plant to ease the peak period load on the national grid, it was possible to obtain a more favourable off-peak tariff. Accordingly a Belliss & Morcom D6 twin cylinder engine direct coupled to a 100 kw Lancashire Dynamo and Crypto alternator with extension shaft to an exciter was installed in a sub basement. This, in summer, was found to provide excess capacity and three years later a C6 compound engine with similar, but 65 kw, equipment joined the original plant. This set works in parallel with the grid from Monday to mid-day Saturday during summer, the larger set operating during the winter months. In the event of a complete grid failure, both engines would be brought into use. Switchgear is by Lancashire Dynamo Switchgear (1958) and Lancashire Dynamo Nevelin, of Oxted.

Daniel Adamson of Dukinfield built the three 9' x 30' Lancashire boilers, numbers 9819, 9820 and 9821, in 1937. Formerly they worked at 100 psi but with the installation of the engines their blow off pressure was uprated to 125 psi, working at 80-90 psi through a pressure reducing valve when process steam only is required. Forced draught machinery is by the Bristol Fan Company and oil firing by Clyde Fuel Systems equipment installed in 1953 to deal with CTF 200. Back pressure steam at 15 psi is fed into a manifold for distribution to kitchens, laundry and to the three domestic and four heating calorifiers. The latter feed a closed circuit radiator system while two of the former work in conjunction with 7,000 gallon thermal storage tanks converted by the engineering staff from old Lancashire boilers and which provide a much greater reserve of hot water than would otherwise be possible. The steam mains return to a hot well for boiler feed.

While the generating equipment is quite a recent innovation, the first steam engine at the hospital was installed in 1864 to pump water.

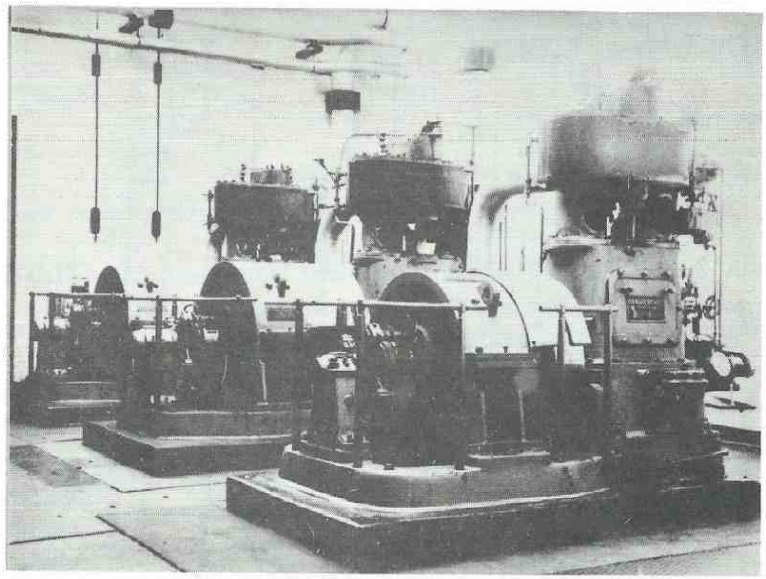
SUMMARY OF ENGINE DETAILS

(Sites are listed in North-South order as indicated on the map)

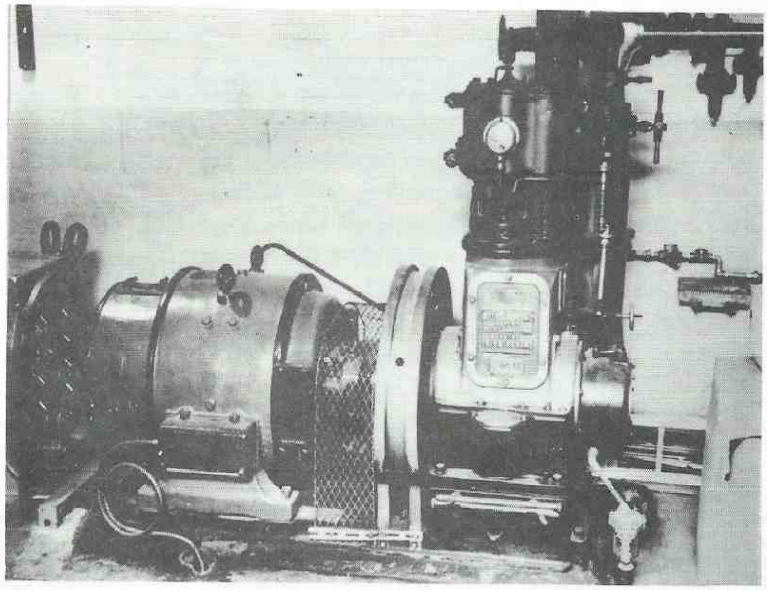
SITE		ENGINE	DATE	TYPE	BORE & STROKE	PRESSURE STEAM	PRESSURE BACK	DRIVE	GENR.	AC DC	KWS	VOLTS	AMPS	RPM	BHP
GLENSIDE	1	B & M-11371	1958	D6	11 + 11 x 6	110	10/15	Direct	LD & C	AC	100	414	174	600	150
		B & M-11381	1960	C6	11 + 15½ x 6	110	10/15	Direct	LD & C	AC	55	415	113	600	98
ST MONICA	2	B & M-6875	1923	C4	7½ & 12 x 6	140	3/5	Direct	English Electric	DC	50.5	220	230	575	75
		B & M-6876	1923	C4	7½ & 12 x 6	140	3/5	Direct	English Electric	DC	50.5	220	230	575	75
		B & M-6877	1923	C4	7½ & 12 x 6	140	3/5	Direct	English Electric	DC	50.5	220	230	575	75
HOMOEOPATHIC	3	B & M-7061	1923	S4	8" x 5"	110	5	Direct	Metro Vickers	DC	20	220/230	89	600	32
BARROW	4	A|llen-R1 63932/2	1937		6½ & 10 x 5	180/200	20	Direct	Allen	DC	40	500	80	600	60
		Allen-R1 63925/2	1937		8½ & 14 x 5½	180/200	20	Direct	Allen	DC	80	500	160	600	120
		Allen-R1 63925/4	1937		8½ & 14 x 5½	180/200	20	Direct	Allen	DC	80	500	160	600	120
WINFORD	5	B & M-8313	1929	C4	7 & 12 x 6	150/155	5/10	Belt	LD & C (1960)	AC	52	415	90.5	1500	80
		B & M-8967	1929	C4	7 & 12 x 6	150/155	5/10	Belt	LD & C (1960)	AC	52	416	1500	80	

Thanks are due to W.H.Allen Sons & Co. Ltd., Belliss & Morcom International Ltd., Bristol and West Tar Distillers Ltd., the engineers of the South Western Regional Hospital Board and in particular to Messrs. Gerrish, White and Vowles for their patient assistance and advice.

ALLEN ENGINES AND DYNAMOS AT BARROW HOSPITAL



BELLIS AND MORCOM S7061 ENGINE AND METRO - VICKERS DYNAMO AT THE HOMOEOPATHIC HOSPITAL



BRISTOL AREA HOSPITAL GENERATING CAPACITY