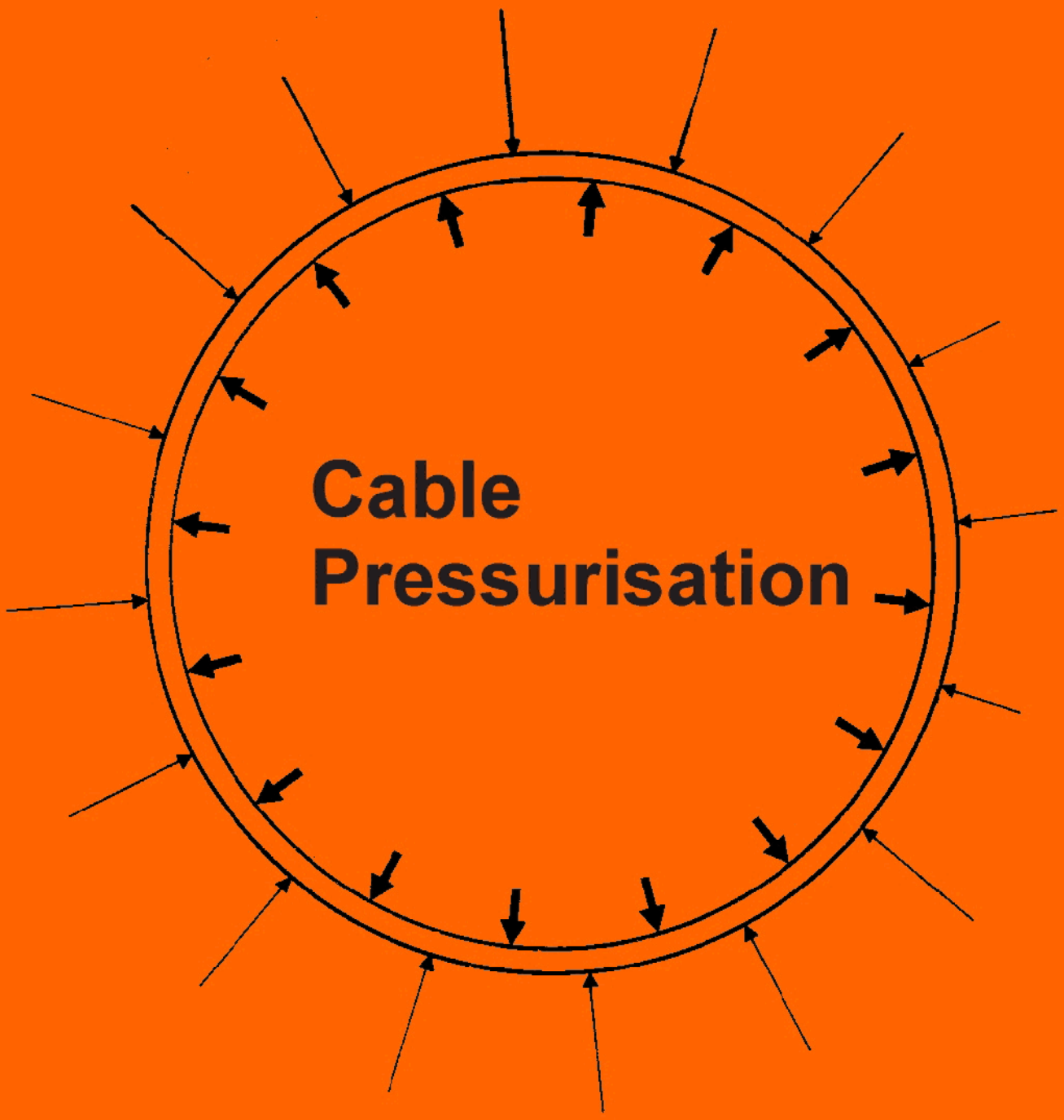

Cable Pressurisation

Notes for Internal Students

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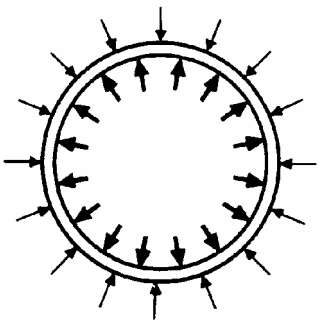
Cable Pressurisation

A short appreciation of the need for the awareness by all staff, both internal and external, of cable maintenance methods and aims.

Service Department Telecommunications Headquarters

POST OFFICE



Dampness causes overhearing between subscribers

The Cables

The greater part of the interconnecting cables are laid underground in earthenware ducts. These ducts, between manholes, are continuous pipes of approximately 34 inches in diameter. The cables vary in size from as little as a quarter of an inch to nearly three inches in diameter, containing many thousands of wires. Some cables

contain coaxial tubes which may carry as many as ?,700 simultaneous telephone conversations.

Until recent years the wires were insulated from each other by insulating paper and then protected by an overall continuous lead sheath. Modern cables have a polythene or lead plus polythene sheath, but dry paper is still the usual form of conductor insulant

Unfortunately, because of traffic vibration, corrosion, human activity, etc., cracks or holes occur in the sheath and joints and as the cables are underground, dampness and even water car, enter the cable. This dampness reduces the insulation resistance of the paper, affects signalling and causes overhearing between subscribers. In the extreme case the cable can become completely unusable and has to be replaced. This costs time and money and can affect subscribers for many hours.

Cable Pressurisation

To prevent water and dampness affecting cables the Post Office in 1963 decided to pressurise all trunk, junction and large local, cables with dry air. Thus, providing the pressure inside the sheath is kept greater than the pressure of water outside the sheath no water or moisture enter and damage the insulating paper.

Two systems of pressurisation were adopted

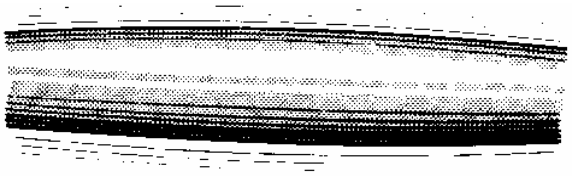
1 Static

In this system all sheath defects are cleared and the cables "pumped up" until a pressure of 9 lb/in.^{2} is obtained throughout the cable. The cable is then monitored with pressure contact gauges and contactors located at discrete points along the complete length of the cable. If a leak develops which causes the pressure to fall by more than

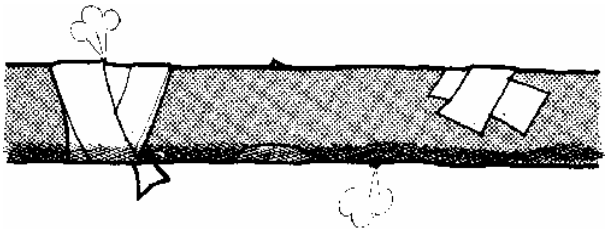
1 lb/in.^{2} per month action is taken to locate and repair the crack or hole. (Some short cables have a higher permitted rate of fall.)

If the leak rate is less than 1 Ib/in.^{2} per month the only action required is the occasional '"topping up" to the nominal standard of 9 Ib/in.^{2}.

This system of pressurisation is used on all trunk and junction cables.



Static System



Continuous flow system

Location of leaks in pressurised cables

2 Continuous Flow

In this system air is continuously pumped into cables at the exchange at a pressure of 9 lb/in.^{2} and providing the pressure at any point along the cable is not less than 3 lb/in.^{2} and the flow of air into the cable does not exceed 1 cu. ft/hr. no action is taken to locate and repair the leaks. The cables are monitored at the exchange by flowmeter and by pressure contact gauges at the distant end. The latter give an alarm signal to the exchange if the pressure falls too low.

This system is applied to cables in the local distribution network between the exchange and (normally) the distribution cabinets. It was adopted because the complexity of the local network makes it uneconomic to locate and clear every leak to reach a static standard.

Maintenance Methods

Because two systems of pressurisation were adopted it was necessary to devise two methods of maintenance

1 Static System-Trunk and Junction Cables

This system is maintained in normal circumstances by relying on internal maintenance staff to make frequent observations of the pressures on the gauges in exchanges and repeater stations and reporting the readings to the External Plant Maintenance Control (the nerve centre of the external maintenance organization). From summaries of these readings it is possible to determine whether or not a leak has developed and, if so, the approximate location of the crack or hole

In the event of a sudden large leak developing an alarm contact in the pressure gauge or alarm contactor in the cable operates and rings an urgent alarm in the exchange.

2 Continuous Flow-Local Cables

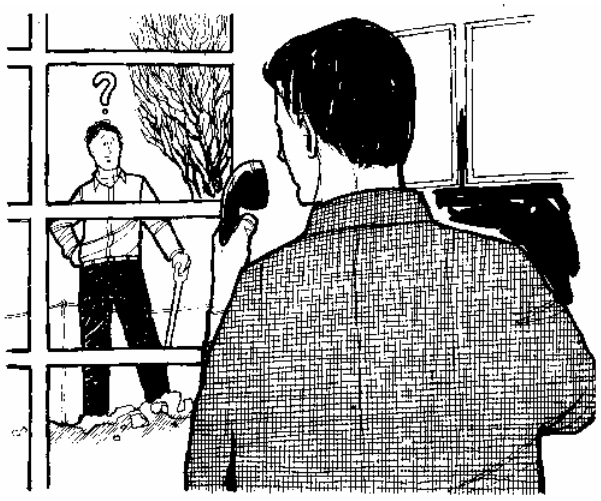
This system is maintained by internal maintenance staff observing the flow rates into the cables at the exchanges and reporting to the E.P.M.C. any excessive flow of air and also any alarm condition received from a distant cabinet pressure gauge.

Location of leaks in pressurized cables

When the flowmeters, gauges, or contactors in a cable, indicate that the pressure can no longer be maintained within the required limits, the external maintenance staff measure the pressure distribution along the section of the cable where preliminary gauge readings, etc., show where the leak is most likely to be. The pressure is measured at jointing points where a Schrader valve has been fitted to the jointing sleeve.

Good intentions can cause a lot of unneccesary work

Please keep an eye on 'Potential knob twiddlers"



In real emergency... ask for Freefone 111

Sensitive manometer or aneroid type pressure gauges are used to make these measurements and a pressure/distance graph is drawn, the lowest point on the graph indicating the position of the fault. The actual leak position is then confirmed by leak detecting solutions, arcton tracer gas, ultrasonic detectors, or even visually. This is a relatively simple operation provided the pressure conditions are controlled and correctly set up. Unfortunately, this fact is not usually appreciated by many people not acquainted with pressure location methods and "good intentions" can cause a lot of unnecessary work.

Where You Can Help

The external maintenance organization is very dependent on other staff for its information on pressurised cables. In fact, the exchange and repeater station staff are the eyes of the cable people

With a little understanding and co-operation you can save the Post Office time. money and, not least, the energy of your colleagues. the external jointers All that is required of you is

(1) Please do *not* touch the MU and CJ air controls on the pressure feed racks (E.C.P. No ...) without first speaking to the External Plant Maintenance Control. You may think you are doing someone a good turn if you turn air on to release an alarm but in all events you will probably upset the conditions for a good pressure run.

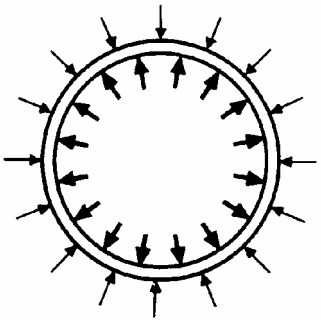
(2) Please keep an eye on strangers, be they jointers" mates or high ranking executives, if they stand talking near the pressure equipment racks. They may be "potential knob twiddlers", for it is a human failing that causes some people to twiddle, sometimes unconsciously, sometimes just to see the effect , and the flowmeters and gauge contact alarms are particularly fascinating in this respect. A polite cheery word to these people if you should see them about to touch a knob to ask if they would oblige and record the details in the station log might well reduce the amount of unauthorised knob twiddling.

(3) Please do not alter alarm settings without first contacting the E.P.M.C.

(4) Please keep a "weather eye" on the gauges and flowmeter between routine readings. You may save the emergency man being called out that night-particularly to the unattended exchanges and repeater stations.

(5) Please telephone the E.P.M.C. the routine pressure readings promptly when it is your turn to co-operate.

(6) Please keep an eye on alarms, particularly those which are almost continuously being shown "receiving attention" and complain bitterly to the E.P.M.C. if necessary.



(7) Remember that, wherever you may be, in real emergency advice on any problem affecting cables can be obtained from the E.P.M.C. by simply calling the telephone operator and asking for Freefone 111. Whilst this service is primarily provided for damage prevention purposes, it is useful to remember that one need never be out of touch, because one has forgotten the normal telephone number.

T.H.Q./Sv5.2.2/D.C.G. (D. C. GREGORY)
May 1969

Appendices

Additional information on cable maintenance is attached as follows

Appendix 1-Glossary of terms used by external staff.
Appendix 2-List of relevant Engineering Instructions.

Appendix 1

Glossary of Terms used in Cable Pressurisation

Air Blocks	To prevent air leaking out of the cables at the exchange or repeater station, cables are provided with air-tight seals at the cable termination point. They are usually situated in the cable chamber or trench and are made using Resin Packs No. 2. They are also used where it is necessary to isolate sections of cable.
Air Lines	Used to connect air supplies to cables and also for by-passing loading pots and air blocks where necessary. Tubing, Aluminium ¼ " P.V.C. Sheath is used in buildings Polythene-, ¼ " Natural is used in manholes, etc.
Air Line and Equipment Connexions	Connectors Compression . .. are used to connect tubing together and tubing to associated apparatus.
Air Inlet	The point where air enters the cable.
Connector Cable Air No. 1 A	Used to connect air to a lead sheathed cable.
Connector Cable Air No. 2	Used to connect air to a polythene sleeved joint.
Schrader Valves	(Valves Air No . . . .), Pressure test points on cables.
Pressure Indicators	Pressure Gauges No.2.0-10 p.s.i. These include an alarm contact and are normally fitted on pressure equipment racks and in cabinets.
Cable Contactors	Sealed alarm units, installed on or in cable joints or amplifier boxes, which operate at a predetermined pressure setting
C. R. Es	Case Repeater Equipment Nos.. . . . are housings containing intermediate amplifiers and are normally situated in joint boxes set in the footway.
Air Spur	An air pipe from a cable into a building for monitoring purposes, e.g. from a cable which normally passes by outside a repeater station or exchange.
E. P. M. C.	External Plant Maintenance Control - Headquarters of the cable maintenance organization.
E.C.P.	Equipment Cable Pressurising No. . . . . Rack consisting of pressure gauges, flowmeters, air supplies, etc.

Flowmeter	The air feed control point on the pressure equipment rack. Indicates the flow rate in 0.1-1 .0 cu. ft/hr. Consists of a glass or perspex tube with a tapered bore. A conical float in the tube assumes a position relative to the air flow. Normallyfitted on the E.C P
Freefone 111 Service	The emergency cable damage telephone service which connects the caller via the operator to the E. P.M.C.
Pressure Test Points	Provided by Valves Air No..., popularly known as Schrader valves.
Manometer No 1 B	The basic instrument used by jointers to determine the pressure distribution in a cable. It is a single-limb mercury manometer with a range 0-9.5 Ib/in.2 and a sensitivity of 0.02 lb/in.2.
Manometer No. 2A	This is a sensitive, inclined, differential pressure gauge having a range of ±0.2 in. water gauge and a sensitivity of 0.005 in. water gauge. It is used at a joint for determining the direction of flow of the air in the cable.
Manometer No 3A Mk.l	An aneroid manometer having a range of 360-610 ins. water gauge absolute and a sensitivity of 0.02 in. water gauge. Used by Precision Testing Officers where extreme accuracy is required, e.g. the location of an air leak in the cable length necessitating an excavation.
Manometer No. 3A Mk. II	A second type of precision aneroid manometer having a range of 360-610 ins. water gauge absolute and a sensitivity of 0.02 in. water gauge.
Arcton	A tracer gas diluted with air, used for injecting in pressurised cables when it is required to pin-point the exact location of a leak.
Arcton Mixer	An instrument used to dilute pure arcton with air to give 3% Arcton, 97% Air mixture. Used as part of the "Arcton Test Equipment".
Detector Leak No. 2A	A 11 0 V. A.C. operated detector used for detecting arcton gas.
Ultrasonic Detector	A battery operated air leak detector consisting of hand-held probe and amplifier case. Used for detecting the energy created by air escaping from a hole in a pressurised cable. The detector is tuned to cover the ultrasonic band of frequencies (35.000 Hz-45.000 Hz)
Air Bottle	Cylinders of dry compressed air having a capacity of 110 or 165 cu. ft. Used to maintain pressure, near a leak point until a permanent repair can be made, or in length adjacent to a cable joint opened by a working party. Fully charged they register about 180 Ib/sq. in. on the high pressure gauge associated with the reducing valve.
Compressor-Desiccators	Used in exchanges and repeater stations to provide a source of compressed then dried or desiccated air for pressurised cables. In small stations the two are combined on the pressure equipment rack ; in large stations the compressor is separate and usually situated in the power room.
Humidity Detector	A detector on the pressure rack which operates if the moisture content of the air being fed to the cables exceeds a certain level (normally when the dew point exceeds -32°C).
Murray Bridge	A bridge on the pressure rack used for locating the position of operated alarms at contactor points or gauges at distant stations, etc.
Leak Solution	(Solution Leak Detecting.) A liquid used for "painting" on joints during fault location. A leak is indicated by bubbles.

Appendix 2

Engineering Instructions Relevant to Cable Pressurisation

Lines, Underground 1…	A series of Engineering Instructions dealing with the design and application of cable pressurisation to trunk, junction and local cables.
Tests and Inspections General B 1890, B 4310 to B 4313	Tests and methods for locating faults in pressurised cables.
Lines, Utilization, S 3004	Pressure alarm circuits.
Tests and Inspections Lines, B 5102	Maintenance testing of pressurised cables.
Tests and Inspections General, B1803, B1804, B 181 2 & B 1814	Descriptions of equipment for locating and monitoring pressure alarms in pressurised cables.
Tests and Inspections Routine, L 5013, L 5190, L 193-L 5197, L5175	Maintenance routines on: Continuity of alarm circuits. Pressure gauge readings. E.C.P's Nos. 1, 2, 3, 4A and 5A. Functional tests on Bridges Murray 5A and 6A including calibration.
Tests and Inspections Routine, Q 5020, Q 5131-Q 5134 Lines, Udg., 11020 and 15010-I 5012	Maintenance of Compressor-Receiver No. 2
Tests and Inspections Routine, Q 5022, 0 5104 &Q 5107	Compressors No. 2 and No. 2C
Tests and Inspections Routine, Q 5023, Q 5110, Q 5111, Q 5140 Lines, Udg., 1101 5 and 1501 5 to 1501 9	DesiccatorAuto No. 1. With Detector Humidity No. 1A.
Tests and Inspections Routine, Q 502.4, Q 5115-Q 5120, Q5140 **Lines**, Udg., 1101 6, 15025 to 15033	Desiccator Auto No. 2 and No. 2A.
Tests and Inspections Routine. Q 5025, Q5150, Q 5151 & 0 5140 **Lines**, Udg., 11017 and 15040 to 15045	Desiccator Auto No 1 A with Compressor No 1A
The Post Office Electrical Engineers Journal for Jan./Apr./Jul./Oct 1963	A series of four articles on the pressurisation of telecommunication cables
Post Office Telecommunications Journal,	Articles on the application of air pressure to cables. Autumn 1963, Summer 1965, Winter 1965