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Equipment for Spraying Styropor, an Insulating Material

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An equipment for depositing beads of styropor, a thermal and sound insulating material, on a variety of substrates, has been designed and fabricated. The cost of fabrication of the equipment works out to about Rs 5000. The cost of spraying comes to about Rs 35/sq m.

STYROPOR is a superb thermal insulating material. A 1 cm thick layer of styropor provides thermal insulation equivalent to that provided by a 20 cm thick brick wall.

Against the recommended value of a minimum of 75%, the thermal damping of a conventional 115 mm RCC slab roof with 90 mm lime concrete and cement ash was found to be 63% in tests conducted at this institute. For lighter roof construction, the value would be still lower and it could be improved by using thin layers of thermocole slabs made out of styropor beads. Their use is very common in buildings and other industries. These slabs are most suited for the insulation of flat surfaces. They are not suitable for curved, round and other intricate surfaces. For such special applications, styropor beads are sprayed along with a suitable resin to form a layer which is not only good as a heat insulating medium, but has excellent sound absorbing qualities also. Styropor in sprayed form is mainly used for such applications as: (1) thermal insulation of all types of building construction and railway coaches, (2) improving the acoustics in auditoria and halls, and (3) decorative purposes. On account of weathering effects on styropor, it is normally recommended for indoor applications only. An equipment for spraying styropor, designed and fabricated at this institute, is described in this communication.

Description of the equipment

The equipment consists of the following components: (1) the aggregate (styropor) container, (2) trolley carrying pressure feed vessels, and (3) the nozzle head.

Aggregate container — The container (Fig. 1) is a 35 litres capacity closed pot with stirring arrangement, which is filled with the granular aggregate. At the lower end of the container is an injector through which the aggregate is conveyed to the nozzle head by compressed air. The injector is supplied with compressed air through a pressure regulator for adjusting the quantity of air and in turn styropor according to requirements. The container is light and is mounted on wheels, making it portable.

Trolley — The pressure feed vessels containing liquid resin are mounted on a trolley which is also portable. Both the pressure feed vessels are provided with hand operated stirring arrangements together with the usual fittings like safety valves, pressure regulator, pressure gauges, etc. Each pressure feed vessel has an inner bucket into which the liquid resin is charged through an inlet provided in the lid of the vessel. The outlet for the resin which is also connected through the lid runs down to the bottom of the inner bucket and is provided with a filter. The air inlet to the pressure vessel has also been provided through the top lid.

Each pressure vessel can be connected to the nozzle head, one at a time, thus enabling the charging, etc. to be done in the other vessel.

Nozzle head — The nozzle head (Fig. 3) is developed as a three-gun system, having two coplanar guns for resin spraying and a central gun for styropor blowing. The resin nozzles are opened and closed by means of compressed air, by operating finger levers. These nozzles

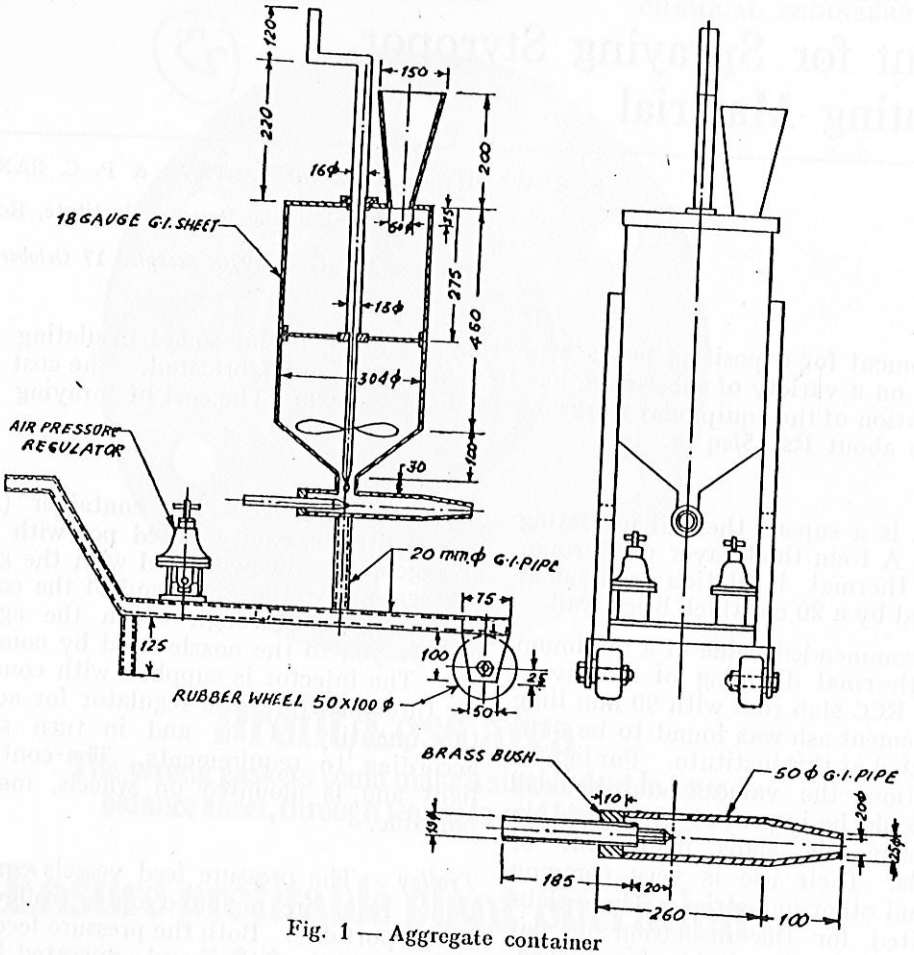

Fig. 1 — Aggregate container

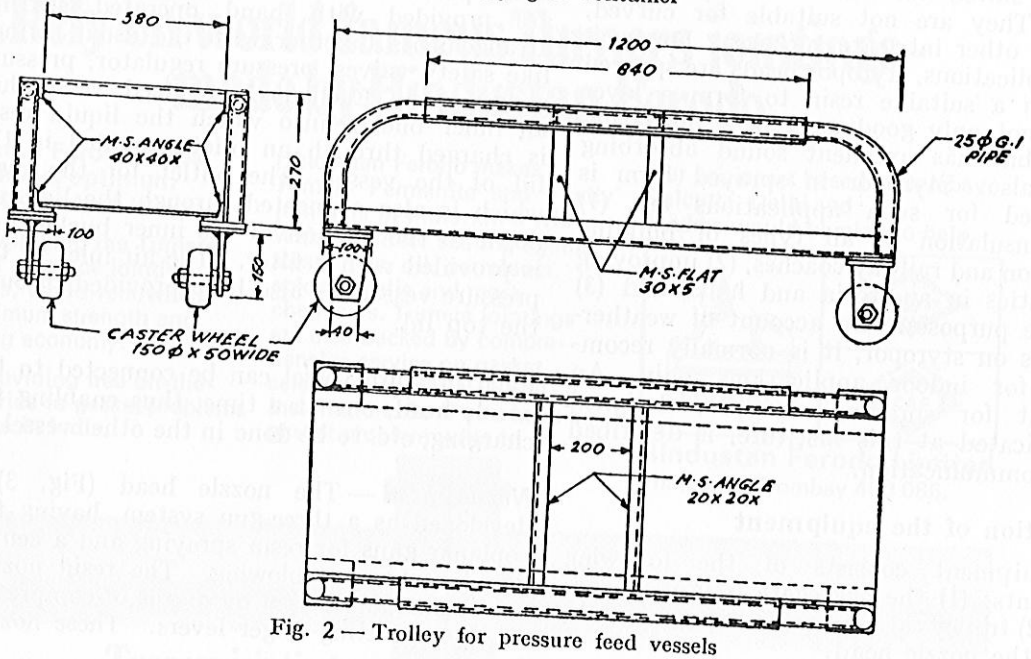

Fig. 2 — Trolley for pressure feed vessels

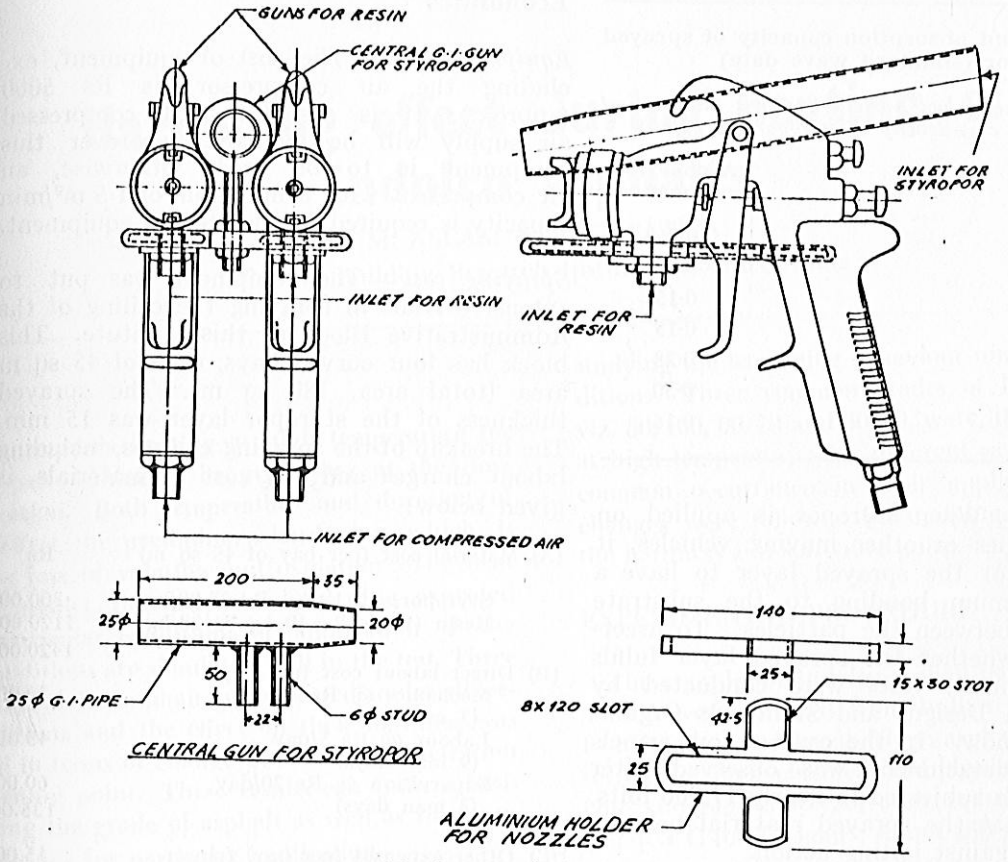

Fig. 3 — Nozzle head

can be opened to different extents by regulating screws. In this way, the quantity of resin can be increased or reduced smoothly and continuously as required and any desired mixing ratio can be obtained.

Between the two resin nozzles is a holder in which the nozzle for the granular aggregate is held. It is, therefore, possible to spray the resin and the aggregate separately as well as together. The angle between the resin nozzles can be increased or decreased according to requirement. Thus, it is possible to moisten the aggregate stream and mix the resin immediately in front of the gun or slightly beyond.

Resin — For general purposes, commercial PVC resin (Fevicol) diluted with water to a viscosity of 30-40 sec of DIN cup works very well with styropor beads.

Performance tests

To ascertain the behaviour of the sprayed layer of styropor beads under stationary as well as dynamic conditions, the following performance tests were conducted: (1) thermal damping or thermal resistance tests, (2) acoustic tests, and (3) jolting tests.

*Thermal damping or thermal resistance tests** — In respect of thermal performance, styropor in the form of compressed slabs is no doubt the best of all the insulating materials currently available. It was observed that the thermal damping or thermal resistance of sprayed beads of styropor is in no way inferior to that of compressed slabs. The results of a typical test were as follows:

Size of test sample: 30 × 30 × 25 cm
Room temp.: 39°C
Thermal conductivity: 0·051 kcal/hr °C.

*Acoustic tests** — Sprayed styropor is quite effective as a sound absorbing medium (Table 1).

*Conducted in the Efficiency of Buildings Division of the institute.

Table 1 — Sound absorption capacity of sprayed styropor (standard wave data)

(The mounting used had a rigid backing; thickness of coating, 1·25 cm; density of styropor, 15 kg/m³)

Frequency c/s	Absorption coeff.
125	0·06
250	0·08
500	0·15
1000	0·15
2000	0·28
4000	0·50
NRC	0·16

Jolting tests — When styropor is applied on railway coaches or other moving vehicles, it is essential for the sprayed layer to have a certain minimum bonding to the substrate and also in between the particles. To ascertain as to whether the sprayed layer fulfils this requirement, tests were conducted by the Research Designs and Standards Organisation, Lucknow. In the case of four panels tested, no detachment was observed after they had been subjected to nearly 17,000 jolts, indicating that the sprayed material behaves excellently against jolting action.

Field trials

The spraying of styropor beads was carried out on the ceiling of the Administrative Block of this institute over an area of 200 sq m. This ceiling is of funicular shell shape. Spraying to a thickness of 15 mm was carried out in 1972 and has withstood changes in humidity, moisture and temperature over the past four years.

Economics

Equipment cost — The cost of equipment, excluding the air compressor, is Rs 5000 (approx.). It is assumed that compressed air supply will be available wherever this equipment is to be used. Otherwise, an air compressor with a minimum of 1·5 m³/min capacity is required to operate the equipment.

Spraying cost — The equipment was put to extensive trials in spraying the ceiling of the Administrative Block of this institute. This block has four curved bays, each of 45 sq m area (total area, 180 sq m). The sprayed thickness of the styropor layer was 15 mm. The breakup of the spraying charges, including labour charges and the cost of materials, is given below:

	Rs
(A) Material cost (per bay of 45 sq m)	
Styropor=12 kg @ Rs 25.00/kg	300.00
Resin (Fevicol)=40 kg @ 28/kg	1120.00
	1420.00
(B) Direct labour cost (per bay)	
Mechanics @ Rs 10/day (3 man days)	30.00
Labour @ Rs 5/day (9 man days)	45.00
Supervision @ Rs 20/day (3 man days)	60.00
	135.00
(C) Other expenses (per bay) (power, old newspapers, etc.)	15.00

Total (A+B+C)=Rs 1420+135+15=Rs 1570
Spraying charges per sq m=Rs 1570/45
=Rs 34.90 say Rs 35/sq m.

References

1. Building Digest No. 39, Central Building Research Institute, Roorkee.
2. INDOPLAST Limited, *STYROPOR News, No.* 5, (Chemicolour Private Ltd, Bombay), Nov. 1965.