A Compact Lightweight Heat-Dissipating Cabinet

1. INTRODUCTION

In recent years, with the improvement of communications infrastructure, many cases arise where communications equipment are installed outdoors, including remote terminals for the access systems of fixed telephone service and base stations for mobile phone systems. There is also an increasing need for implementation of high-capacity, compact and lightweight communications base stations aimed at increasing the capacity and speed of communications (i.e. broadband communications) and supplementing the dead zones of mobile communications.

To protect the delicate communications equipment from adverse outdoor environments such as dust and water, cabinets accommodating these equipment have to be sealed in compliance with the JIS grades 4 or 5. But sealing of the cabinet is likely to accumulate the heat generated by the communications equipment, so that having an efficient technology for heat dissipation has become important for the downsizing and weight reduction of base stations.

A type of cabinet that takes in outdoor air without careful consideration can, although heat dissipation is obviously done efficiently, result in the worst environment for electronic equipment where the dust, dirt and moisture may cause disadvantages such as rapid degradation of electronic components, short-circuiting and defective contacts, because the electronic components are directly exposed to the outdoor air. Thus such a cabinet frequently causes a failure of equipment soon after installation.

While Furukawa Electric has been offering sealed cabinets incorporated with various heat-dissipating devices for a range of communications equipment such as remote terminals and the base stations for mobile communications, the company lately put into practical application a heat-dissipating cabinet for the base stations of mobile communications that is compact and lightweight as well as low in noise.

2. DESIGN CONDITIONS

(1) Size
- Dimensions: (W) 250 × (D) 390 × (H) 590 mm
- Mass (including cabinet, heat exchanger and fan): 20 kg or less

(2) Heat generation rate of communications equipment contained: 600 W
(3) Temperature limit: Ambient (50°C or lower) + 20°C or lower
(4) Noise: 50 dB or lower

3. STRUCTURE OF DEVELOPED HEAT-DISSIPATING CABINET

3.1 Cabinet

(1) Material: Aluminum except for hinges and the like made of stainless steel
(2) Structure: As shown in Photo 1 and Figure 1

Photo 1 Appearance of cabinet.

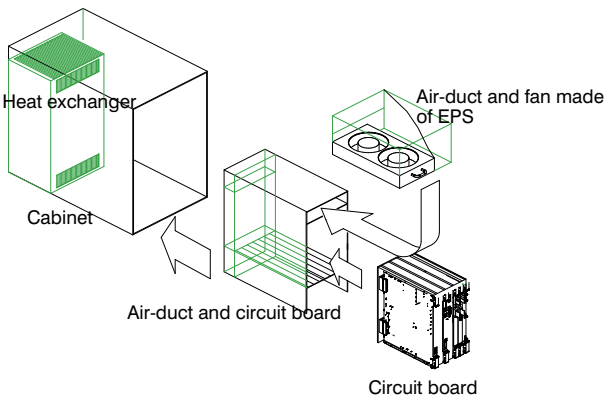

Figure 1 Schematic of cabinet.

(3) Features:
- A heat-shielding plate is provided to suppress heat input due to sunshine.
- Expanded polypropylene manufactured by Foam Chemical Products Co. has been adopted as the substrate for communications equipment and the supporting member for the fan, thereby forming a smooth airflow channel to reduce the pressure loss as well as to improve noise insulation.

(4) Dimensions: (W) 250 × (D) 390 × (H) 590 mm

(5) Mass: 17 kg

3.2 Heat Exchanger

(1) Material: Aluminum

(2) Structure: As shown in Figure 2

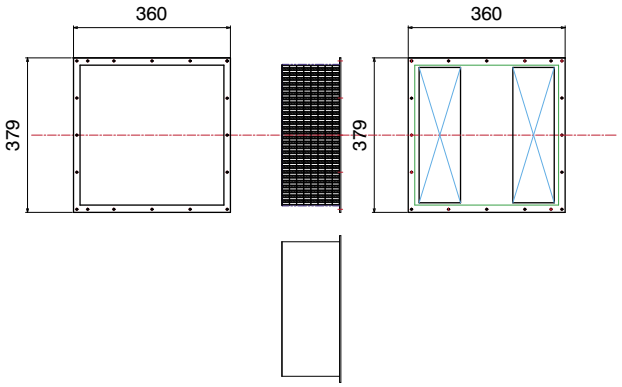

Figure 2 Heat exchanger.

(3) Features:
- The outdoor and indoor air countercurrently flow in their own airflow duct, without mixing with each other due to the water-tight sealing.
- The use of extruded channel bar provides a large surface area.
- Noise due to the internal fan and the like hardly leaks because of the tight sealing.
- To reduce the weight, a narrow-pitched fin of folded corrugation was used achieving a weight reduction of approximately 5 kg.

3.3 Heat Exchanging Method

(1) Heat exchanging method
- Forced air cooling using the inside and outside fans. See Figure 3.

(2) Heat exchange
- The indoor and outdoor air exchange their heat via the aluminum plate in the thickness direction. See Figure 4.

4. PERFORMANCE OF DEVELOPED HEAT-DISSIPATING CABINET

(1) Thermal performance: As shown in Table 1
- Temperature rise: 20°C or lower at a heat generation rate of 600 W
  : 10°C or lower at a heat generation rate of 300 W

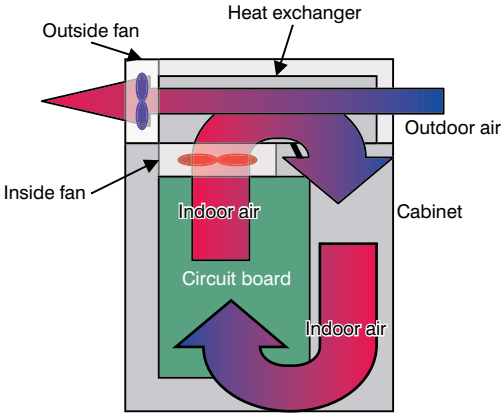

Figure 3 Airflow in cabinet.

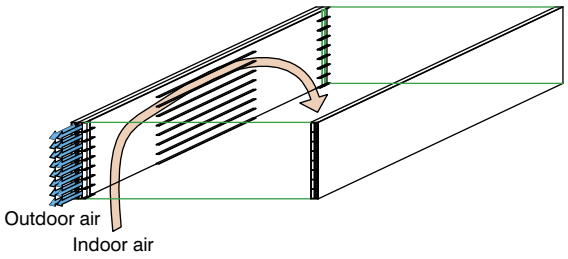

Figure 4 Airflow in heat exchanger.

Table 1 Thermal performance under full-load condition.

	Item	Measured value	Calculated value
1	Power consumption (W)	227.71	227.7
2	Input heat from AMP and AC/DC (W)	84.5	84.5
3	Ambient temperature (°C)	27.7	27.7
4	Airflow velocity at inlet (m/s)	—	—
5	Airflow velocity at outlet (m/s)	—	—
6	Airflow velocity between fins (m/s)	—	5.87
7	Temperature at heat exchanger inlet (average, °C)	42.75	43.7
8	Temperature at heat exchanger outlet (average, °C)	37.3	38.4
9	Temperature rise (average, °C)	9.6	10.7
10	Thermal resistance (°C/W)	0.031	0.034
11	Cooling capacity (W/°C)	32.52	29.18

- A heater simulating the equipment was accommodated in the cabinet, and the rise in inside temperature was measured using simulated heating. The simulated heating included the inside heating of 310 W and the calculated input heat due to sunshine of 10 W.

(2) Noise: The experimental setup and results of noise measurement are shown in Photo 2 and Figure 5, respectively.
- 50 dB or lower in all directions in case of folded corrugation fin.

(3) Other performance
- Water-tightness: JIS C 0920, grade 5. See Photo 3
- Earthquake resistance: 7 on the Japanese intensity scale

Photo 2 Experimental setup for noise measurement.

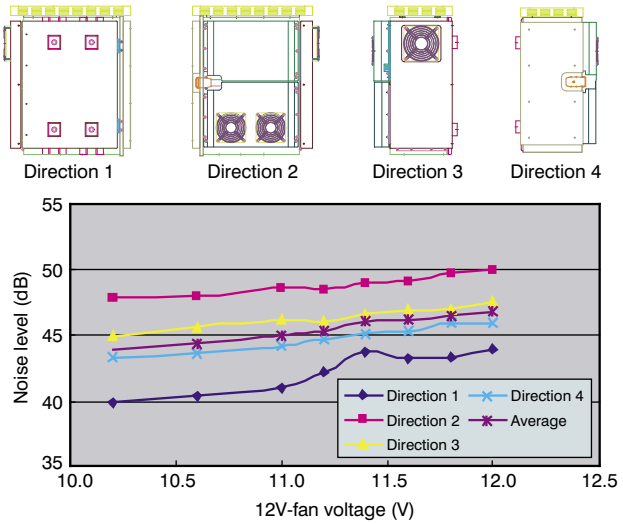

Figure 5 Results of noise measurements.

Photo 3 Water-tightness test.

- EMI: VCCI class A. Shield gaskets were applied over the openings.

5. CONCLUSION

Furukawa Electric has developed various heat-dissipated devices such as large-size to mini-size heatpipes, heat-sinks incorporating these heatpipes and thermally conductive sheets together with related technologies, thereby offering a variety of thermal solutions.

Making best use of the above mentioned technologies, the heat-dissipating cabinet presented here has been successful in offering an integrated solution to the problems of increasing the capacity and speed of communications including high-heat dissipation, downsizing, weight reduction as well as noise reduction.

While it is anticipated that the capacity and speed of communications tend to show further increase, we plan to respond, as a total thermal problem solver, to the diversified customers' needs by developing efficient heat dissipation technologies and by offering proposals for downsizing, weight reduction and cost reduction.

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