APPENDIX A

Cost Benefit Scenario

R.E. Platts, Scanada Consultants

Market Scenario

C.E. Bonnyman, Scanada Consultants

A - 1 Mr. Platts' prepared presentation

A - 2 Condensation of Mr. Bonnyman's remarks along with his graphic material and information collected on work outside of Canada

A - 3 Discussion

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CONTROLLED VENTILATION WITH EXHAUST AIR HEAT RECOVERY FOR CANADIAN HOUSING

Keynote address for the CMHC industry/science seminar 26 Oct 1978
by R.E. Platts, C.E. Bonnyman
Scanada Consultants Limited Ottawa & Toronto

A - 1 Mr. Platts' Presentation

The end product, the Canadian house: We like to think of the house as an engineered product now, the end product of a big industry, nicely evolved over generations. And that it is, in many ways, but excepting at least one basic fundamental wherein today's model is unchanged from the millenia of predecessors.

The fundamental: the air that the house feeds to its occupants, and to furnace or fireplace for that matter, is "accidental", a matter of unplanned leakages in the building fabric.

Unplanned, undesigned, rather unstudied accidental leakages, varying substantially as you will hear today from Dr. Stephenson. Still loosely wasting heat energy in very many of our houses even as built now, but sometimes too tight in the same house next door, ie. not leaky enough to dissipate humidity and control condensation odours, deposits of grease and tobacco tar.

The "accidental breather": Older housing in Canada leaks away through the cold winter at an average rate of perhaps 3/4 or 1 air change per hour (no one has ever measured or analysed them), accounting for about one quarter of the large heating bill of such uninsulated 2-storey prewar houses, or say a winter air change heat demand of $330 now (600 gal oil, or 18000 kWh). Recent bungalows might average about 1/3 ac/hr, entailing an ac heating demand about one fifth to one quarter of the much smaller heating bill, or say $64 (117 gal oil, 3400 kWh). The same applies for semis and row units.

Often enough, today's housing runs at less than a quarter ac/hr, and even a fifth or less if electrically heated (with no combustion air demand pulling through a little more air), and these are often troubled and damaged with excessive condensation; one fifth ac/hr seems to be the general lower limit according to Ontario Hydro and NRC experience.

So 1/3 ac/hr represents a reasonable benchmark of well constructed trouble-free house construction in our cold country now, and it still throws away about 1/5 of our heating bill into air change. And under that is trouble; the lower limit of air change is very close to how we're building now much of the time.

So, on the one hand we want to tighten up to save energy - - probably we must tighten up - - and on the other hand we can not take the low cost route of simply tightening the envelope further: that way lies widespread trouble and damage.

Nor can we simply tighten up and treat our air, since dehumidifiers are limited intrinsically (at low cost and low energy usage) to drawing down to only 50% RH, no lower...And 50% is too high for the colder part of our winters, unless we go to special construction with triple glazing...open for discussion.

So, the evolving house now faces something that it rarely encountered through its history, a fundamental change: in this case the change from accidental leakage to controlled ventilation with exhaust air heat recovery, to meet the need for energy conservation and simultaneously ensure trouble-free performance of house and occupants.

That's a problem, with surprisingly little dollar savings to promote free-market changeover; but the fundamental will occur sooner or later and does represent a very large opportunity for industry. We will explore the potentials a little before handing over to the scientists and industry people who will come to grips with the need and the opportunity.

The savings potential of exhaust air heat recovery: Appendix 1 sets out the story: Given that our houses are now commonly built fairly tightly, exhaust air heat recovery can not save very much. And even to do that much the house envelope must be tightened "all the way", which work is a contentious part of the cost of the new "air handling package". It's a circle: we can save energy by living in an airtight house only if we blow air through to ensure air quality and avoid trouble, and recover its heat to save energy; and the tightness and the recovery are all one package entailing a capital cost.

The annual energy saving for a small dwelling in most of populated Canada is about 2300-2400 kWh or about 11 Mcf gas or 81 gal oil: about $45. Appendix 1 calculations lean heavily on the Saskatchewan work which in our view is outstanding household-scale work; much more on this today.

The present value of future savings: Put very simply, if the capital cost is not covered by a present value factor of 10 or less (applied to first winter's savings; with energy cost scenarios now it all tends to come out the same as straight "payback period") then it won't sell on the open market: people can hope to do better things with their money. That means that the installed cost of the controlled ventilation/exhaust air heat recovery package, including the radically tightened house envelope, can not exceed ($45 x 10) $450...clearly ridiculous.

From the country's point of view, considering both energy savings and avoidance of condensation damage, perhaps a present value factor of 20 makes sense (no higher: maintenance and replacement costs must be considered). From this viewpoint an installed package cost of up to (45 x 20) $900 may be acceptable, and merits thinking and effort.

(The partial approaches: There will be the Canadian compromise solutions popping up: Leave the house tightness about the same as now (zero extra cost), deploy kitchen and bathroom exhaust fans or a main exhaust fan to be used when needed to avoid excessive humidity troubles, as in electrically heated houses now, and stick heat exchangers directly on those. Extra cost is then only the exchanger costs...plus ductwork to deliver the replacement air to points some distance from the exhaust grills to avoid short circuiting of incoming to outgoing air. The savings: since the fans are needed part time only, and handle only a part of the air change (the rest continues as leakage without heat recovery), the savings can be but a fraction of a fraction of the above $45.)

The costs of supertight envelope: Working quickly and roughly with our work study/cost study of housing construction for HUDAC,* we can offer a first guess at air-tightening costs as if using established routines and materials in volume production of wood frame housing. First, we know from NRC work that exterior walls account for about 60% of the total leakage in today's houses (particularly of 2 storeys). We know from NRC and from our own thermography work that sills, headers and the conjunctions of walls to windows and doors account for most of that. Next the NRC work suggests that ceilings account for a fifth or so, including partition tops, plumbing stacks etc., and finally leakage through (not around) windows and doors comprises about a fifth or somewhat more.

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*Cost Study of a Two Storey Wood-Frame House, Scanada for The Housing and Urban Development Association of Canada, Jan. 1973.

Assuming special care with overlapped polyethylene air barrier, and with limp "gasketry" or foam at all sills, headers and conjunctions, and complete make-good of barrier following all electrical work, we come up with something like 18 man hours and $90 in materials over and above today's "good practice" (which already deploys the polyethylene material, and we assume is deploying good projecting-type windows). Allowing for support labour too, and overheads and profits, we infer an overall extra cost (construction price) in efficient job flow of $390 for the airtight envelope.

If we take $900 as the highest reasonable present value of the whole controlled-air package, then we have at best something over $500 left, after envelope-tightening, to put into the air-to-air recovery system: Eric Bonnyman will start with that.

One more point first:

Living habits: do we throw it all away anyhow? Our house heating field study on windy Prince Edward Island* showed that wind exposure has a surprisingly high proportional effect on the heating bill of any house, but occupants' living habits apparently do not. (The Island sampling was entirely owner-occupied, with the connotation that the occupants cared about and husbanded their heating needs). Separate analyses since then indicate that frequent door opening accounts for a very small part of the heating bill, probably much less than $3 worth a year - - so much for the energy saving value of "air lock" vestibules! Of course, a habitual opening of windows for long periods, to control temperatures or for "fresh air" sleeping preferences, can negate the savings from exhaust air recovery or from anything else. Given an adequate air supply, and

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*Heating Demand Realities Compared with Degree-Day-Based Predictions for Island Housing, Scanada for the Institute of Man and Resources, Charlottetown, October 12, 1977.

knowledge of the dollars lost through the open-window-in-January habit, householders will cure themselves of that habit.

Tomorrow's production model house may be an efficient performer with some costly conserving features which householders can blithely over-ride - - but in the main they won't. Eric will explore the features, costs, and opportunities implied in the fundamental switch to the hardware of controlled ventilation/ exhaust heat recovery.

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Appendix 1

POTENTIAL SAVINGS USING EXHAUST AIR HEAT RECOVERY IN HOUSES

An exhaust/supply air heat exchanger saves energy by allowing us to live in an otherwise air tight house; the corollary is that it demands an airtight envelope to allow it to save energy. Air change can remain high enough to ensure air quality, humidity and odour control, but must be fed in through one point only. Hence the heat recovery "package" is the radically airtight envelope as well as the mechanical ventilation and heat exchanger: all feasible in new construction but all part of the cost. What are the potential savings from that package?

Example bungalow* 96 sq.m, 411 cu.m; 4444 celsius deg. days
[1036 sq.ft., 14500 cu.ft.; 8000 Fahren. deg.days

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1) "As Now": Ample (and normal) lower limit air change, avg.1/3 /

Air change heat loss per°hr. = AC x air spec. heat x density x vol.
=.33 x .0003335 x 411 = .045 kWh/°C hr.
[86.1 Btu/°F hr.]

	Annual kWh	$\times 10^{-6}$ Btu
= annual load .045 x 24 x 4444 x .71**=	3408	11.7

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2) "New package": Envelope infiltration AC .05/hr.
Heat exchanger effectiveness 0.9 (Both from Sask.)
Infiltration heat loss per°hr. = .05 x .000335 x 411
= .007 kWh/°hr.

	Annual kWh	$\times 10^{-6}$ Btu
=annual load .007 x 24 x 4444 x.67** =	500	1.7
losses "past" heat exchanger (handling .28 AC/hr. to ensure total AC of .33, with above infiltration) =(1.0-0.9) (.045-.007) x 4444 x 24 x .67**=	272	.9
Losses in mechanical venting say 50 watt net, (8 mons.)	292	1.0
	1064	3.6

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3) Difference (annual savings, 1978 energy dollars)
= 3408-1064 = 2344 kWh [8.1 x 10^6 Btu]
If heat supplied by oil at 60% seasonal efficiency, 29.3 kWh/Imp.ga
100000 Imp.ga

then saving = 81 gal. at 55¢ = $45/yr.

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*Applies also to 2 - storey,semi or row units of equiv. size
**allowing for "free heat" proportion of the loss for such a house

A - 2 Mr. Bonnyman's Presentation

Picking up generally from Bob's theme, and working with the dollars left after he has taken out his portion to create a "supertight envelope" I would like to focus our attention for the next short period on three aspects...

First - the NEED and OPPORTUNITY in terms of market size
Second - another look at the ECONOMICS
Third - a brief review of what has been done, and what is apparently available, in other countries... especially in Europe, and in Japan.

We have on the program today some gentlemen who will be describing heat recovery units that have been developed here in Canada, and the brief overview of foreign products that I will present is not intended as a basis of comparison against Canadian development, but simply to be used as background informatic

Also, our quick look at market size and opportunity is presented simply to add some perspective, and will be given further attention in the industry presentation this afternoon dealing with Manufacturing and Marketing Constraints.

Let us first look at the overall size of the market for <u>installations in new housing</u>. The level in Canada - i.e. single-detached, semi-detached, duplexes, and row units - is currently running at 160,000 to 180,000 per year. A large portion of these...about 75%...are single-detached. Ontario and Quebec markets combined account for half - about 85,000 to 90,000 per year - again the porportion of singles about 75%. The Prairies account for about 38,000 units per year, singles representing about 71%.

In considering the potential for sales of heat recovery units for the single dwellings within our market - assuming no 'forced need' i.e. imposed initiatives - and assuming the unit can be shown to have a reasonable payback period...that is, disregarding "need" based on social, enviromental, or political grounds...one could assume a market penetration of possibly 10% in the early years - i.e. a market demand in the range of 16,000 to 18,000 throughout the country. A 15% penetration would create demand of 24,000 to 27,000 units per year - a market value of perhaps $7. to $8. million. Now when we start talking such figures we are probably getting into the magnitude of numbers where it would be attractive for two or three manufacturers to go into production. Perhaps we will be provided with more insight into this aspect this afternoon. In the meantime, this identifies, in a rather simplistic fashion, the market opportunity in the new housing category.

What then is the NEED...from an economic supply viewpoint rather than technical. Let us take another brief look at the economics of a unit.

If, in fact, the heat recovery unit is able to capture only $45 worth of heat from the exhaust air, the system will of necessity have to be available at a fairly low price in order of offer an acceptable, let alone attractive, capital recovery period. For example, dealing with today's interest rates - with prime rate at 10% level - with the projected saving of $45 per year, to realize capital recovery in say 15 years, the investment must not exceed about $350. For capital recovery within a ten year period, investment must not exceed $280. Let us bear in mind that these are only "ballpark" figures, realizing that there are various scenarios that one can work with projecting different rates of energy cost increase, different inflation rates, interest rates, and so on.

Also please keep in mind that we are suggesting the level of potential sales in a competitive market, where a unit competes on the basis of economic feasibility, and is competing openly with other housing components and appliances for the consumer's dollar.

An entirely different rationale can be presented if one wishes to focus more heavily on long-term energy policy and overall benefit to the country - i.e. if such a change is imposed in housing, which would not be different <u>in kind</u> from imposing insulation levels, or double-glazing. In such a situation the market demand could be up in the range of say 150,000 units per year... an annual dollar value of perhaps $40 million, or more. What then would be the reaction of the supply industry?

With this brief overview of market need and opportunity as background, let us look briefly at <u>some</u> of the features of units briefly in other countries...going back some 20 years to the initial development of the "energy wheel".

In the package of information which is available for you to pick up at coffee break or later on, are copies of excerpts from literature of various manufacturers, showing general concepts or details of their product or system...and also some other background data or articles.

Rather than going over then to any extent at this time let me simply name the generic types covered...

thermal wheel - original Swedish design of the munter wheel dates back about 20 years.

...it is still probably the most widely used form of heat recovery device, though in the last few years most of the improvement and new product development has been

parallel plate- in parallel plate units which is the second generic type

Also referenced in some literature are...

cross-flow tube battery -

matrix fan unit - acts somewhat like the thermal wheel.

Run-around coil system

Heat pipe battery -

From the various literature, data was extracted relating to different systems, which is outlined on this chart. Please take note that the data on this chart does not refer solely to "residential" type or size units, but to the systems in general. It is simply data extracted and repeated here as listed by the manufacturer or writer of the article.

At this time I should mention that all of the product literature from abroad, from which the copies of excerpts were made, was collected by Gint Mitalas of NRC and was loaned to us to provide some background on the subject to help make this a more meaningful seminar.

A couple of very brief notes, and then I will close, and turn it back to John. As a matter of reference on these Mitsubishi units and Toshiba units in order to try to get some indication of cost. Now many of these are what I would call "room type", they're like an air-conditioning unit, wall-mounted or ceiling mounted, they are small units. Translating from the Japanese literature and converting yens into dollars so that we have the price in Japan yet in terms of our Canadian dollar, it looks as though these small units range in price from about $110 for the smallest up to about $260 - $270. Now again it does not prove anything, I realize but that is the sort of price range that they are on the market for in Japan. In order to try to get a little better fix on it, there were other components that they had shown, such as range hoods, that we could identify better with and in converting those prices, it appears that the prices for these other small articles were not far off the price that we would expect to pay for a similar item here in Canada. So in other words, I am suggesting that these prices are probably comparable to what we would expect to see for such a unit here in Canada. It sort of compares with th price for a small air-conditioning unit or a good humidifier, and so on. There's one question that I would just like to leave, and maybe some technical people would like to address their attention to this as we go on. The people such as Mitsubishi using this treated paper, they claim high transfer of latent heat through permeability of the treated paper. Now if in fact such occurs and if we do have water vapour transmission coming through from the warm exhaust air and again being picked up by the cold intake air, is this the type of units that we really need and wish to see here, because would this help to solve our humidity problem or would it simply just be changing our air and still leaving our humidity higher than we would like to have it. The humidity, remember we mentioned it as being one of the reasons for the need for ventilation. So with that I would like to close and turn it back to John, and if there are questions we certainly can address ourselves to the questions at the appropriate time.

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CMHC INDUSTRY/SCIENCE SEMINAR

CONTROLLED VENTILATION WITH EXHAUST AIR HEAT RECOVERY
FOR CANADIAN HOUSING

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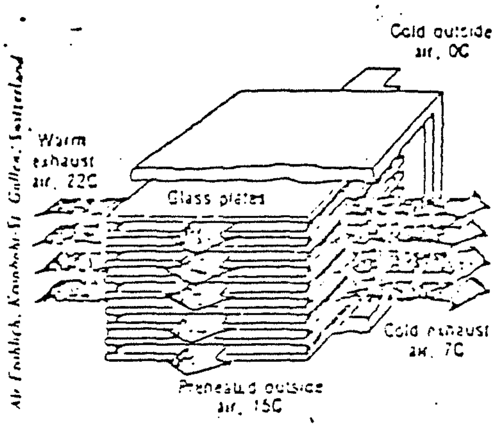
SOME DATA RE: FOREIGN HEAT RECOVERY UNITS

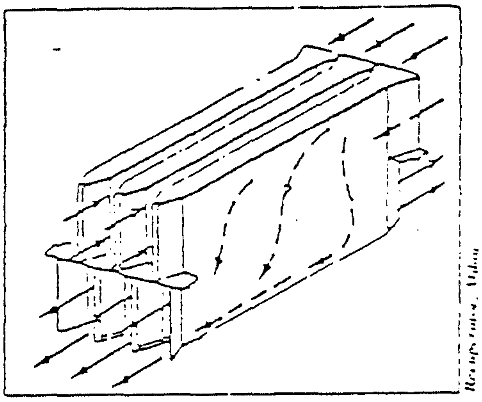
				Listed Efficiencies			
Country	Manufacturer	Type	Separ. Mat'l.	Sensible Heat	Latent Heat	Total Enthalpy Transfer	Est'd. Payback Period
Sweden	V.M.Christensen A/S "Genvex"	Parallel Plate	Al.	62-68%			
Sweden	Flakt "Rexovent"	Parallel Plate	Al.				
Sweden	Econovent "Munter's Wheel"	Wheel - Flat & Corrug. Foils	Inorg. Fibr. Mat'l.			75% up to 90%	1-4 yrs.
Sweden	Ljungdstrom	Wheel	Metal	75-80%	nil		
Sweden	Econovent "Ex"	Parallel Plate	Corrug. Al.Foils				
Japan	Mitsubishi "Lossnay"	Cross - Flow Plate	Plates & Fins of Treated Paper (asbestos)	80%	70%	73%	
Japan	Toshiba	Cross-Flow Plate	Plates & Fins of Treated Paper (asbestos)				
Japan	National						
Italy		Parallel Plate	Al.	peak 90%			1-2½ yrs.
		Parallel Plate	Glass	60-65%			few mths. several y
		"Run-around" Coil		60-75%			
		Heat Pipe	Cu.	55-70%			

PRINCIPLES AND ARRANGEMENTS OF SOME HEAT RECOVERY UNITS



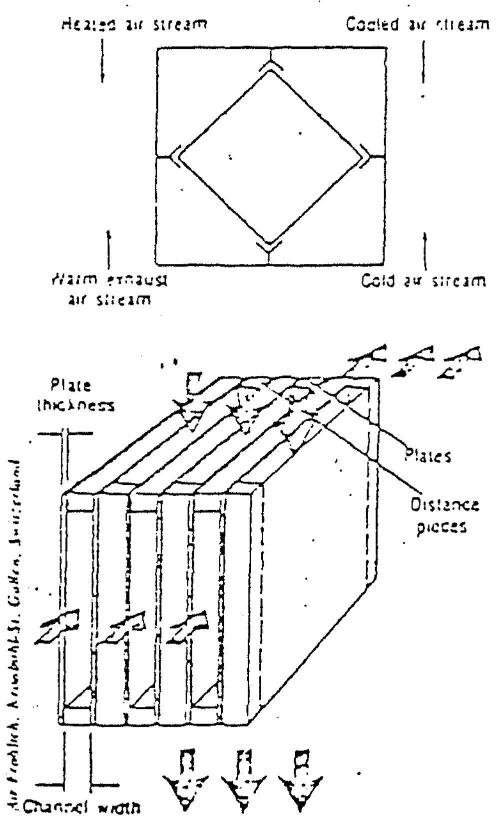
Air Frohlich, Kreuzbuhl St. Gallen, Switzerland

1 Principle of glass plate heat recovery unit.



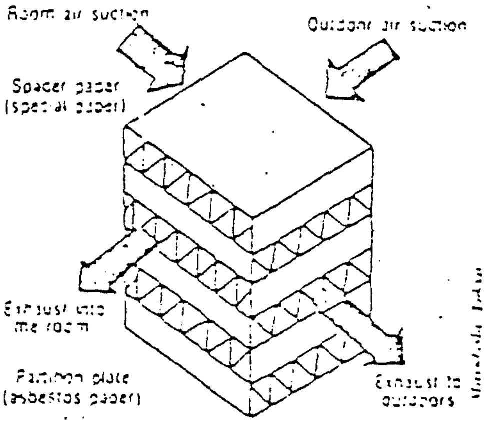
Recuperatore, Milan

3 New Italian design aluminum plate heat recovery unit showing twin deck arrangement for air flow.



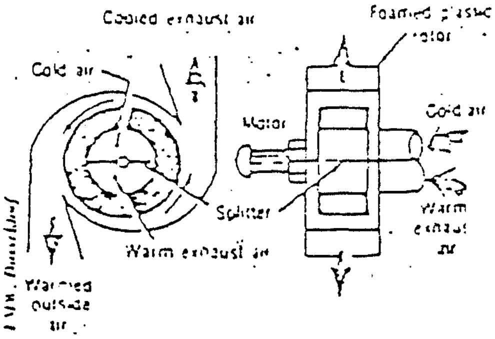
Air Frohlich, Kreuzbuhl St. Gallen, Switzerland

2 Cross flow design in a glass plate unit (tcp), and arrangement in a casing to provide parallel duct connections.



Mitsubishi, Tokyo

4 Japanese design of all-paper heat recovery unit permitting heat and mass transfer.



LVM, Dusseldorf

5 Matrix fan unit. The foamed plastic rotor acts both as a fan and a heat recovery medium

Mechanical Design

Econovent consists of a supporting framework, containing the rotor and the drive motor. The framework consists of side plates connected by spacer plates, and forming a rigid box construction. The side plates are designed for easy connection to air ducts and for installation in an Econovent wall system as shown in Fig. 4.

Adjustable sealing strips are fastened round the periphery of the rotor and along the partition walls between the two air streams to prevent leakage.

The rotor is driven by a motor via a belt.

The main component of Econovent is the rotor wheel which is built up of alternately flat and corrugated foils of inorganic fibrous material, coated with a dessicant. The flat and corrugated sheets glued together form a multitude of axial flutes. The rotor material occupies about 15% of the face area.

Operation

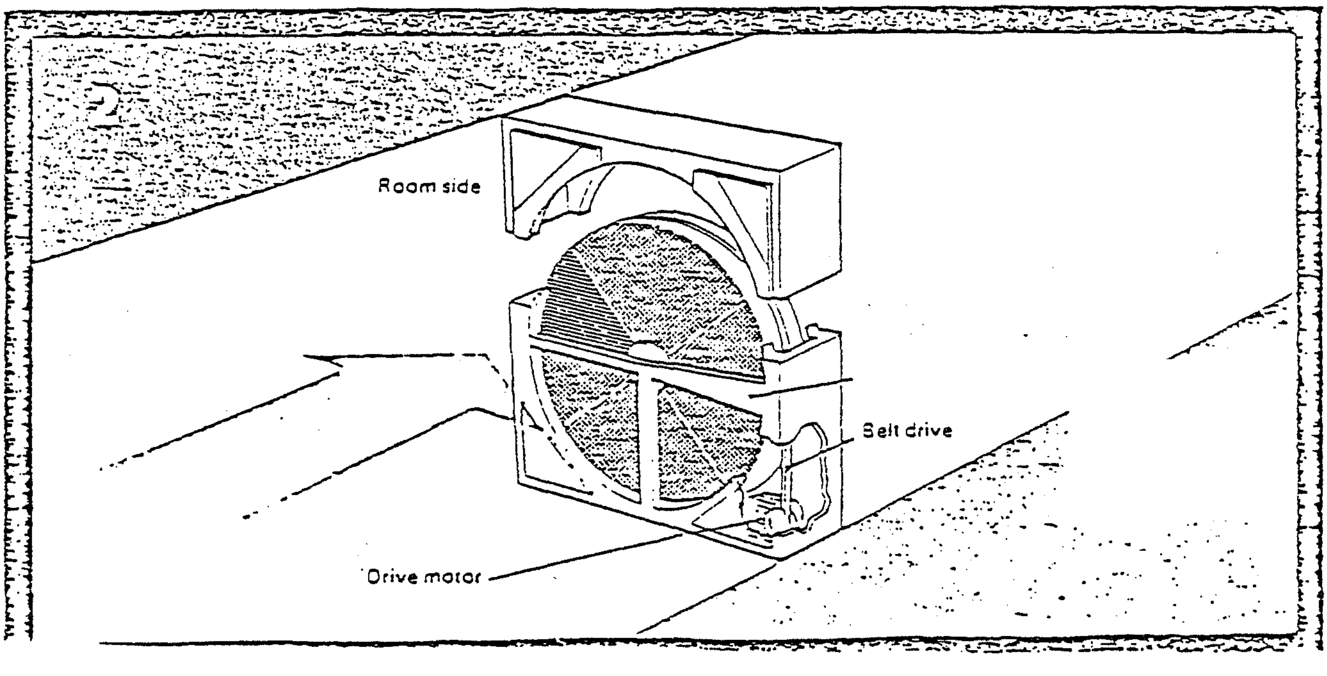
In operation the supply air passes through one half of Econovent and the exhaust air through the other half and in the opposite direction to the supply air. Thus the flutes are alternately passed by exhaust and supply air. As the exhaust air passes through the wheel the sensible heat is absorbed into the matrix and at the same time the hygroscopic nature of the flute walls attracts to itself the atmospheric moisture carrying the latent heat, which is also retained in the matrix. As the wheel rotates into the supply air section, the air passing through the flutes in the opposite direction picks up the sensible and latent heats and moisture retained by the matrix and transfers these back into the building.

Econovent is equipped with a purging sector. In this sector each flute is thoroughly flushed by fresh air before it enters the supply air stream. Tests have proved that the purge sector practically eliminates the transport of exhaust air into the supply air. See special section on 'The Purge Sector'.

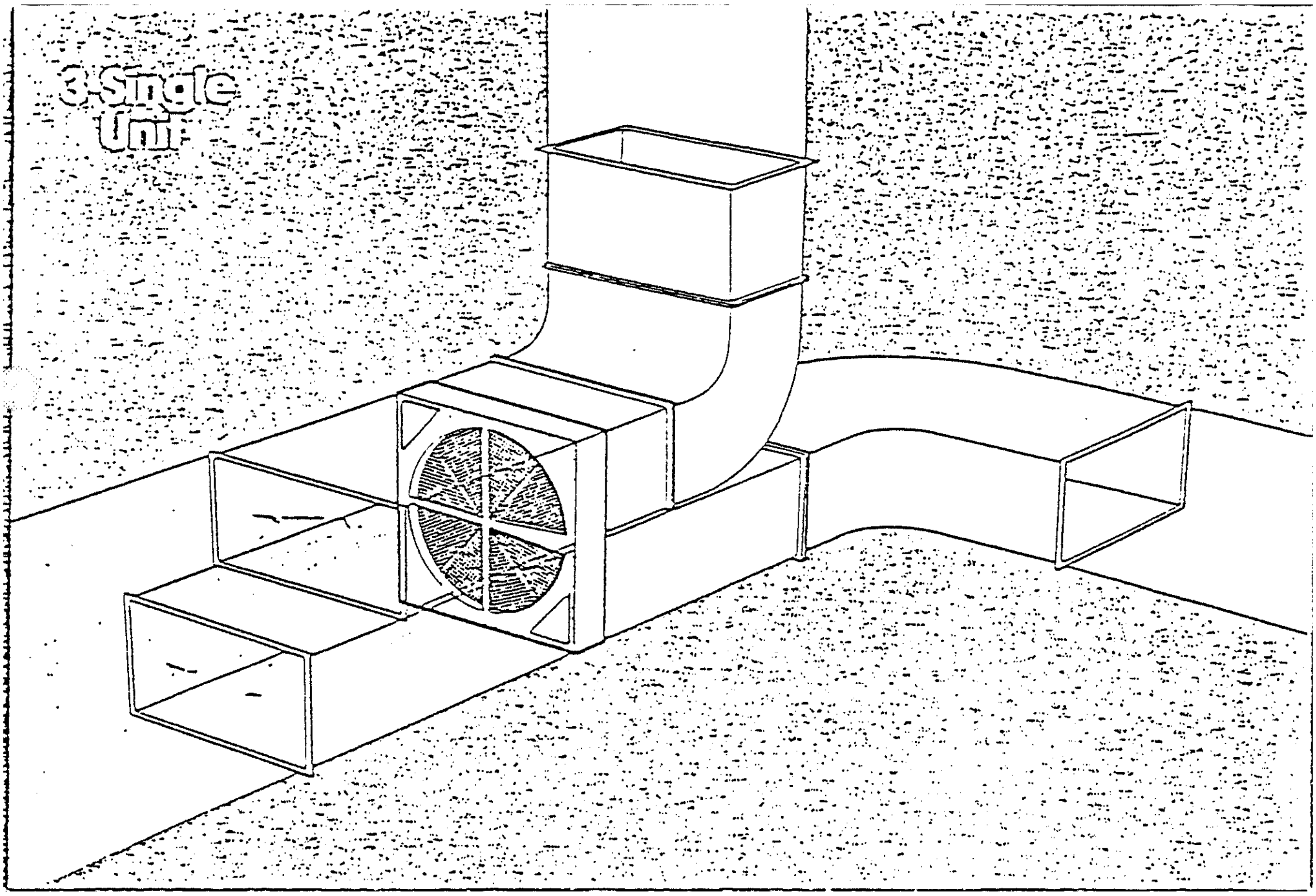
The extremely small flute size of the rotor material would appear to involve a risk of clogging with dust, fibres, etc. However experience from several hundreds of installations has proved that clogging is efficiently prevented by the self-cleaning effect obtained by the continuous change of flow direction through the material.

Naturally a certain protection of the rotor material must be made, and the following recommendations are given.

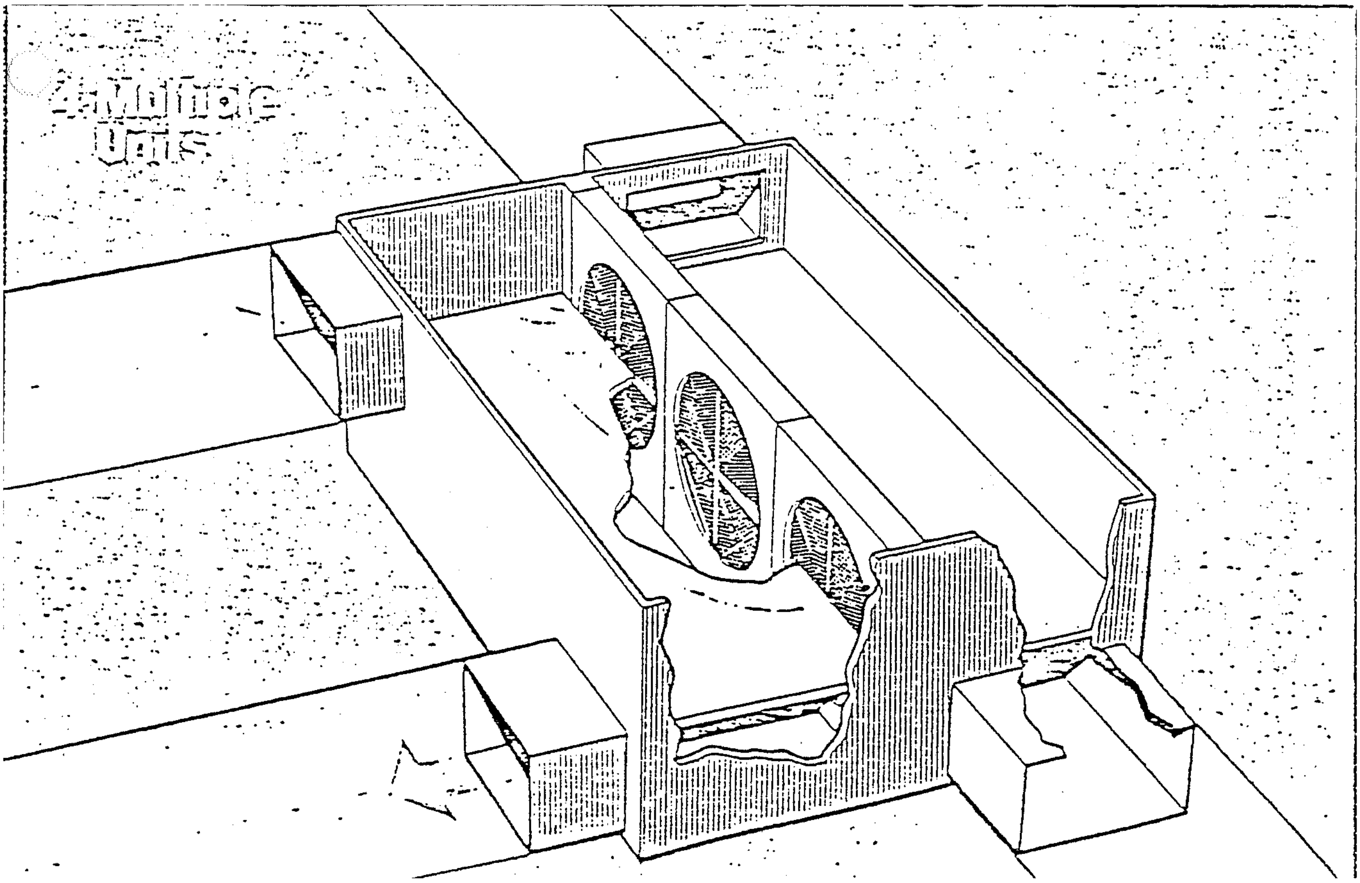
Supply air: Particles larger than the flute size, flies.



Incorporation into the System



3 Single Unit



4 Multiple Units

Reprinted from The ENGINEER 20 November 1975

Use the Munter wheel to recover your heat and make big savings

A rotary heat exchanger that is used extensively throughout Scandinavia can achieve efficiencies of 90% and pay for itself in two years. By Paul Butler

FOLLOWING the installation of a waste heat recovery system on two new printing machines — a solvent coater and a gravure press — security and general printers Harrison and Sons is expecting to save around £30 000 a year on fuel bills.

Most printing machines need large quantities of hot air for evaporating off solvents in the inks and coating materials. Heat is often wasted because the solvent-laden air is commonly exhausted to atmosphere — perhaps after a solvent recovery process.

As fuel prices rose, Harrison decided on a scheme by which about 70% of the heat in the exhaust air stream can be recovered.

The key to the heat recovery system are two Munter's Econovent wheels — one for each machine — which are almost unknown in Britain but have been applied extensively in Sweden where they were developed about 15 years ago.

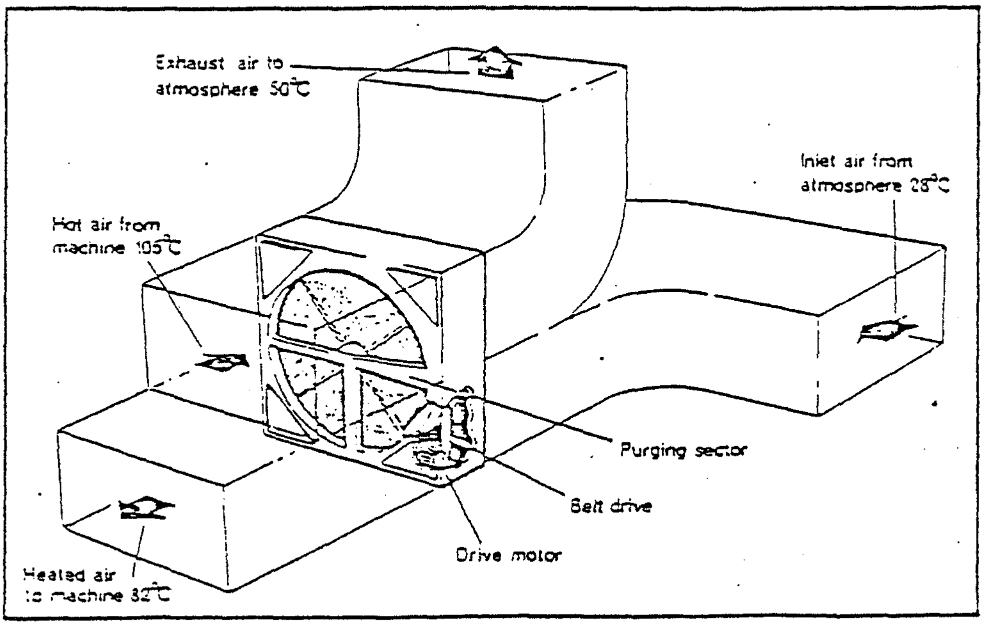
Rotary exchanger. Munter's wheel is in effect a rotary air/air heat exchanger fitted between the exhaust and supply air ductwork in a heating, cooling or ventilating system. A feature is the wheel's ability to recover both sensible heat — in the air stream — and latent heat — in the solvent vapour — achieving recovery efficiencies of 70-90% averaged over a season.

The wheel is not only suitable for heat recovery on printing machines. Many Scandinavian installations have been in hospitals, hotels and other public buildings. One of the few to be installed in Britain so far is in Overseas Containers' London headquarters at Beagle House.

The diagram shows how the wheel fits into the ductwork and is driven by a small electric motor and belt drive at about 10 rev/min. The two wheels at Harrison are each about 2 m (6 ft) diameter and 280 mm (11 in) thick and contain asbestos fibre sheet impregnated with lithium chloride.

Looking down the axis of the wheel is like looking at the end of a roll of corrugated paper. There is a multitude of axial flutes — the asbestos material occupying about 15% of the face area.

How Harrison and Sons is using a Munter's wheel to recover 70% of heat from coating and gravure machines



The fresh air supply from atmosphere passes through one half of the wheel and then to the air heaters on the machines. The exhausted air passes through the other half of the wheel in the opposite direction to the fresh air supply. Thus the flutes are alternately passed by exhaust and supply air.

As the hot solvent-laden exhaust air passes through the wheel the sensible heat is absorbed into the matrix and at the same time the hygroscopic properties of the lithium chloride on the flute walls attract the moisture carrying the latent heat. This is also retained in the matrix.

As the wheel rotates into the air supply section the air passing through the flutes in the opposite direction picks up the sensible and latent heats and moisture retained by the matrix and transfers these back into the system.

Purge section. To avoid transfer of exhaust air into the supply air a purge section on the wheel flushes each flute before it enters the supply air stream. This is particularly important in certain applications where transfer of insoluble airborne odours or particles between the airflows cannot be tolerated. The carry-over is claimed to be only 0·04% by volume.

At Harrison the energy required for heating up the air supply to the coating and gravure machines to 420K (150°C) comes from a Wanson liquid-phase heater circulating Essotherm oil through gilled tubes. The heater has a maximum output of 12 700 MJ/h (12 million Btu/h), at which rate it consumes 0·39 m^3/h (85 gal/h) of 3 500-sec fuel oil.

While Harrison is still building up capacity on its *new machines* — they are operating at around 50% of potential capacity — fuel oil flow to the heater has been cut to 0·05 m^3/h (11 gal/h). This illustrates the enormous savings which will be possible as a result of installing the wheel.

Harrison's total bill for putting in the heat recovery system came to around £42 000—with the two Munter's wheels accounting for £11 000. Payback time is estimated by the company's consultants Michael Bird Associates to be 21½ months. Bird points out much of the £42 000 spent would have been necessary anyway for ductwork to carry exhaust air to atmosphere.

But by putting its own money into a heat recovery scheme — the company had hoped to borrow money through the Government's Energy Saving Loan Scheme but applied 'too early' — Harrison will be saving about £600 a week in fuel bills, and a good deal more if industrial oil prices start rising again. E

U.K. distributor: Acoustics & Envirometrics Limited
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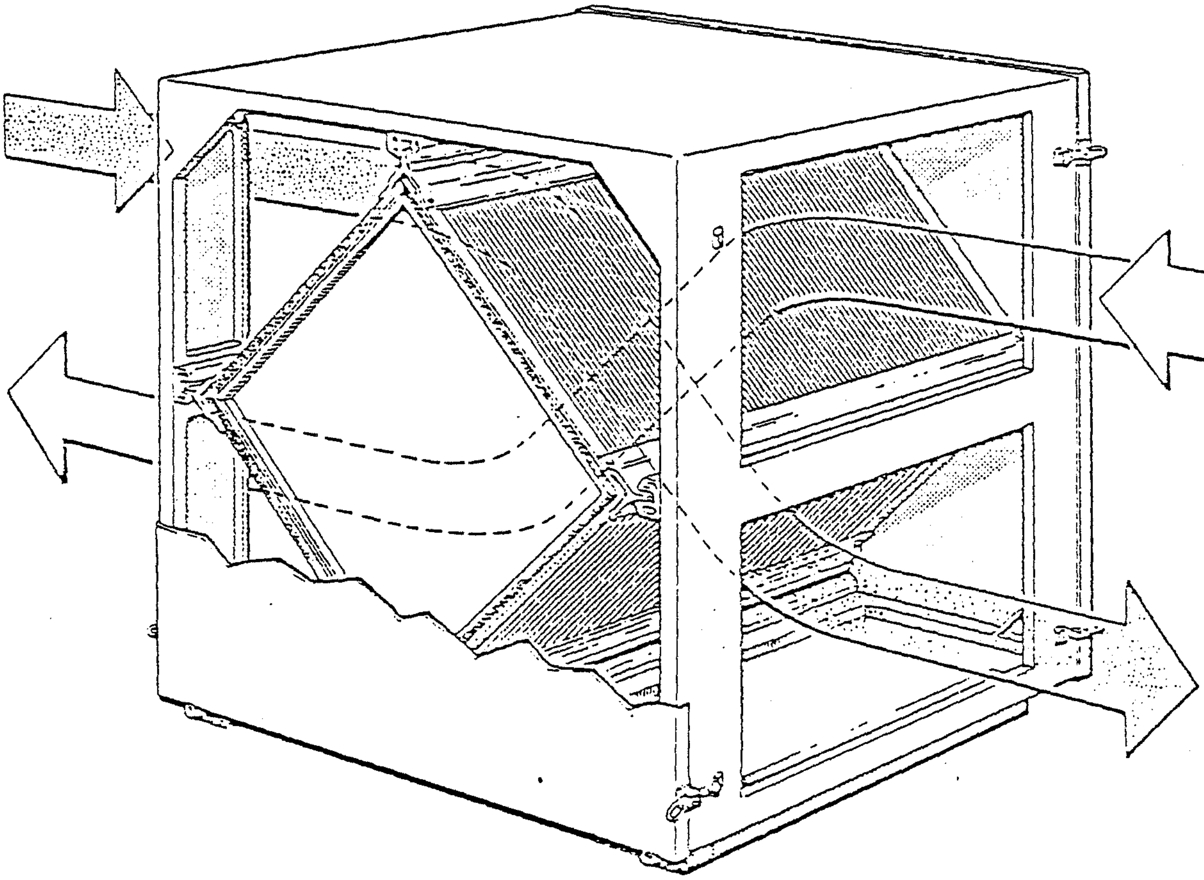

Econovent EX

cross-flow recuperator for energy recovery in ventilation system

Compared with rotating regenerators type Econovent EV or RT the cross flow stationary recuperator Econovent EX — where supply and exhaust air are completely separated — has both advantages and drawbacks. It is necessary to study the pros and cons and relate them to the actual project to choose the best alternative.

One can say as a general rule that the major field of application for Econovent EX is "wet" industry, where one wishes to transfer the high latent heat of the exhaust air into warm, dry supply air. Through the fact that the condensation heat of the exhaust air is transferred to the supply air, one can reach very high supply air temperature efficiency.

Another field of application for Econovent EX is where the vapours from solvents, gases or odours are transferred to an unacceptable rate in Econovent EV.

Typical applications:

Drying of wood and textile, laundries, paper mills, swimming halls, chemical industry and animal housing.

mechanical design

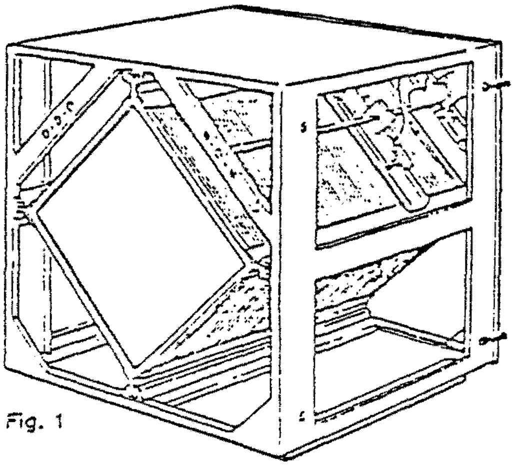

Fig. 1

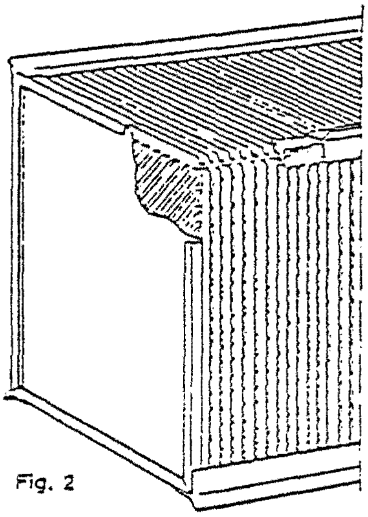

Fig. 2

co[illegible]vent EX recuperative heat recovery module con-
ists of a sheet metal casing containing removable heat
ecovery packs made of corrugated aluminium foils. The
asing has removable end covers on each side to enable
onnection to other modules, when high air flows require
nore than one module. In the bottom of the casing there
re two pans to drain the condensate. There are four
penings for connection to ducts.

he foils of the heat recovery pack, which are exposed
o exhaust air, may be covered with a plastic film to pre-
ent corrosion. The recovery packs can be pulled out of
he casing to enable cleaning.

If required the module can be supplied with a freeze protection mechanism, i.e. a small lid gliding over the pack. The mechanism is located at the outdoor air entrance side of the pack. The lid is driven by a motor by means of a threaded rod attached to the casing. When using several modules — a module "train" — one of the modules (the master) has a drive motor mechanism and the other modules are slaved by the master module. The motor is designed for connection to mains 220 V, 50 Hz, single phase.

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function

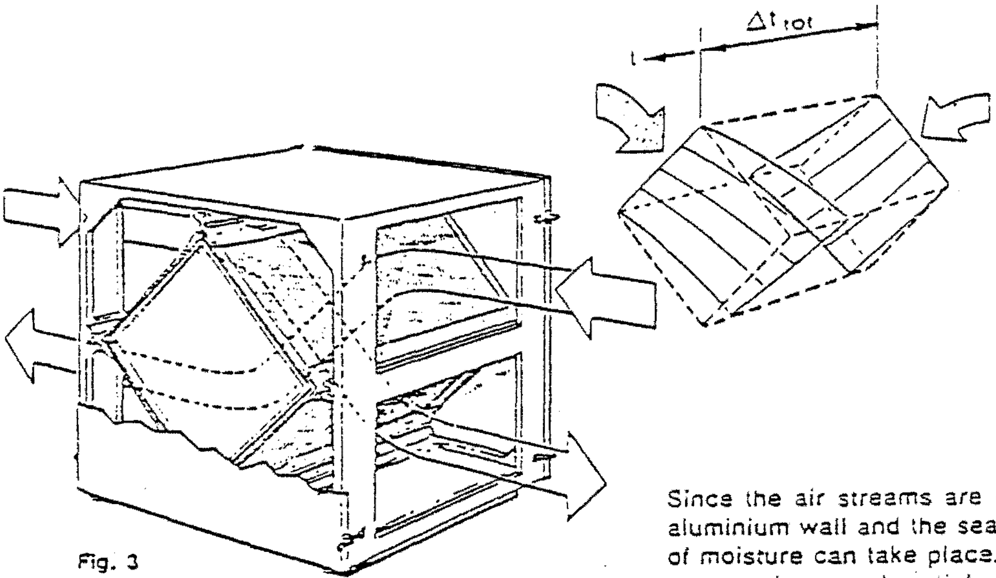


Fig. 3

Econovent EX the air streams normally enter through
e upper openings and flow diagonally through the
odule and exit through the lower openings. If conden-
ate forms, it will be forced down the pack to the drain
ans of the housing.

Since the air streams are completely separated by the aluminium wall and the seals of the housing, no transfer of moisture can take place. The same goes for vapours, gases, odours and particles. The temperature process in a cross flow exchanger like Econovent EX is complicated to describe verbally, but figure 3 shows the temperature process in principle.

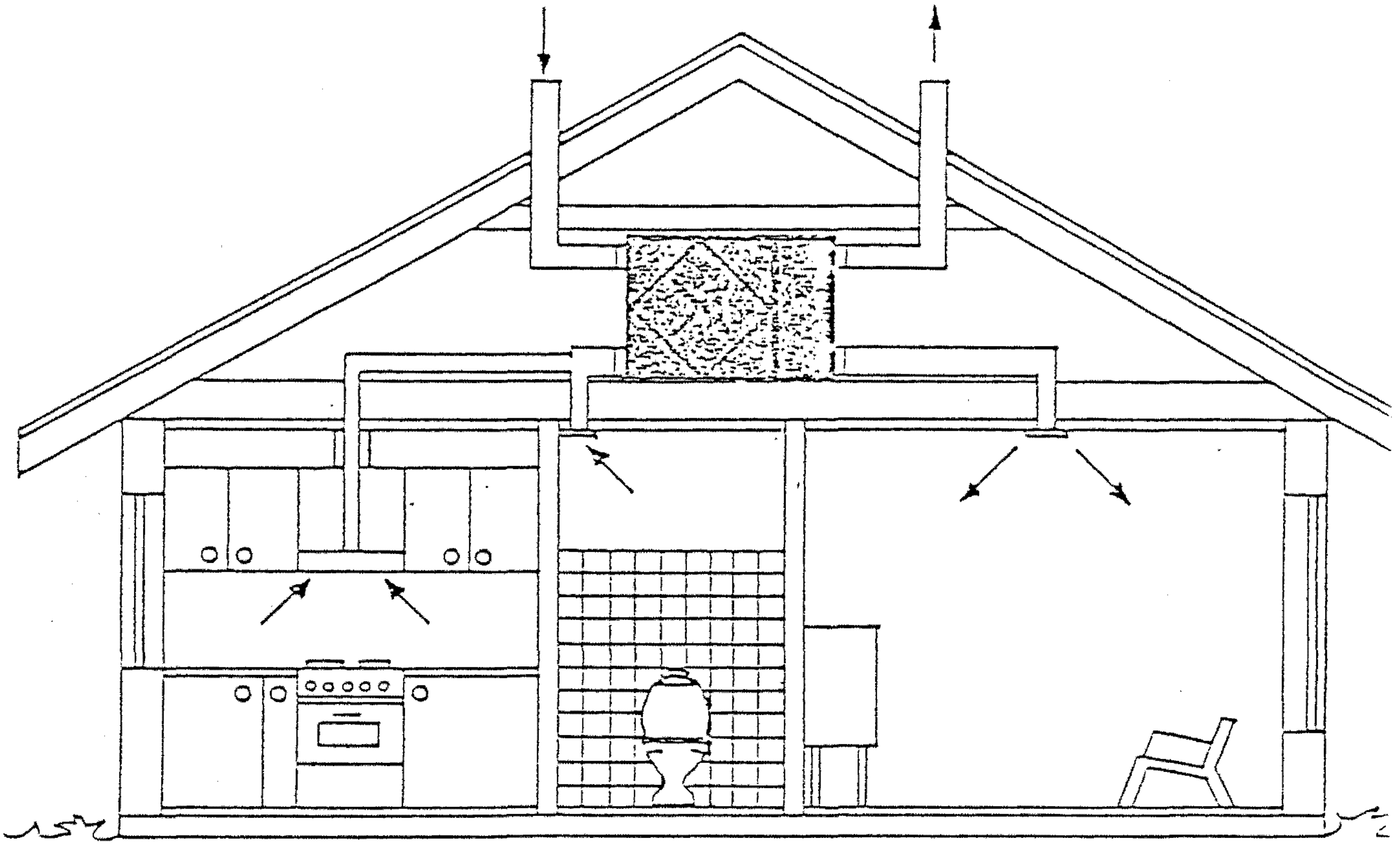
Where the supply air cools the surface of the pack down to and below the dew point of the exhaust air, condensation takes place in the exhaust air flutes.

VMC/
HEAT RECOVERY

VMC GENVEX unit for single-family houses.

VMC INFORMATION

VMC GENVEX UNIT is an energy saving ventilation system, especially developed for highly insulated single-family houses, group- and se detached houses. Apart from improved economy, excellent interior c mate conditions are achieved.



Earlier the air renewal used to be effected by natural means, i.e. through crevices, leakages and by opening windows.

Today energy savings are first of all obtained by insulating and draught-proofing the houses. At the same time you discover that no only the warm air is sealed in but also cooking smells, cigarette smoke and other impurities. Furthermore, this lack of ventilation leads to the probability of excessive condensation. Insurance companies and building authorities are aware of this problem.

The solution to the problem seems to be the placing of extractor f but paradoxically, such ventilators function less effectively in h ly insulated, sealed rooms. By the continuous sucking out of the a inside, a vacuum (non balanced ventilation) is created in the hous

VMC/
HEAT RECOVERY

VMC GENVEX unit for single-family houses.

TECHNICAL SPECIFICATION

VMC GENVEX UNIT is an energy saving ventilation and heat recovery system, especially developed for highly insulated single-family houses, group- and semi-detached houses.

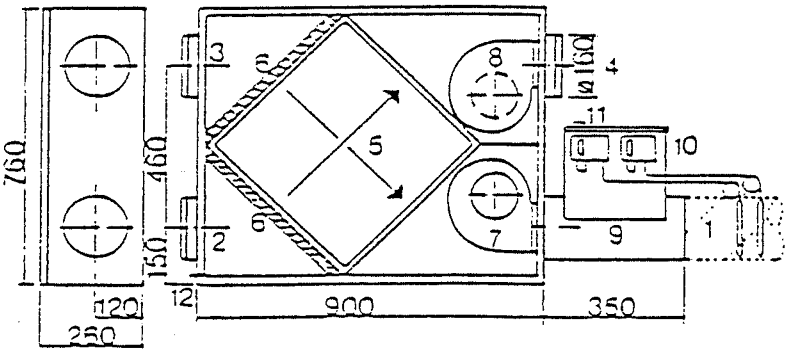
VMC GENVEX UNIT is a compact system, consisting of Cross Air-Flow Heat Exchanger, filters, injection and extraction ventilators with manuel switch from full to half speed.

Normally, the assembly is delivered with 2 thermostatically controlled electrical heating elements for stepwise switching on.

VMC GENVEX UNIT is available in a right-hand and left-hand model.

VMC GENVEX UNIT's Cross Air-Flow Heat Exchanger is manufactured of sea water proof aluminium. The heat transfer is carried out by thermal transfer through crosswise "stacked" aluminium sheets.

Dimensions and components



01. Injection canal
02. Extraction canal
03. Fresh air canal
04. Throw-off canal
05. Cross Air-Flow Heat Exchange
06. Filter
07. Injection ventilator
08. Extraction ventilator
09. Electrical heating elements
10. Thermostats for switching on
    of the heating elements
11. Fire thermostat
12. Condens outlet

VMC GENVEX UNIT is manufactured of spray coated electro-plate, in the colour orange. On the inside the unit is insulated.

VMC GENVEX UNIT has condens outlet. Connection 13/15 Cu-tubes.

VMC GENVEX UNIT recovers 55 - 75% of the heat, dependent on the temperature difference between the fresh and the extraction air, the quantity of air injected and ectracted and the humidity of the extraction air.

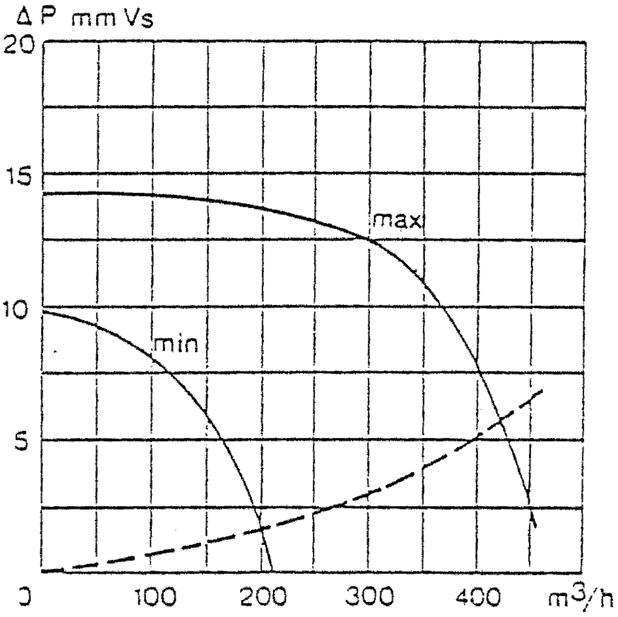
In a normal single family house, the efficiency on annual basis will be 62 - 68% in average.

VMC GENVEX UNIT is equipped with noiseless centrifugal ventilators with temperature working range between ÷ 30° - ÷ 60°.

Data for ventilator

The ventilator wheel is of steel.
Motor type: E 160 - 4
Volt: 1 - 220 V
Max. current: 0,3 A
Condenser: 2 MF
No-load capacity per ventilator:
Max.: 55 - 70 W
Min.: 22 - 25 W

Ventilator characteristics



--- Pressure loss curve
for VMC GENVEX UNIT.

VMC GENVEX UNIT contains 2 filters, fitted with washable viledon mats.

VMC GENVEX UNIT is normally delivered with one canal heating element, fitted on the injection canal of the unit.

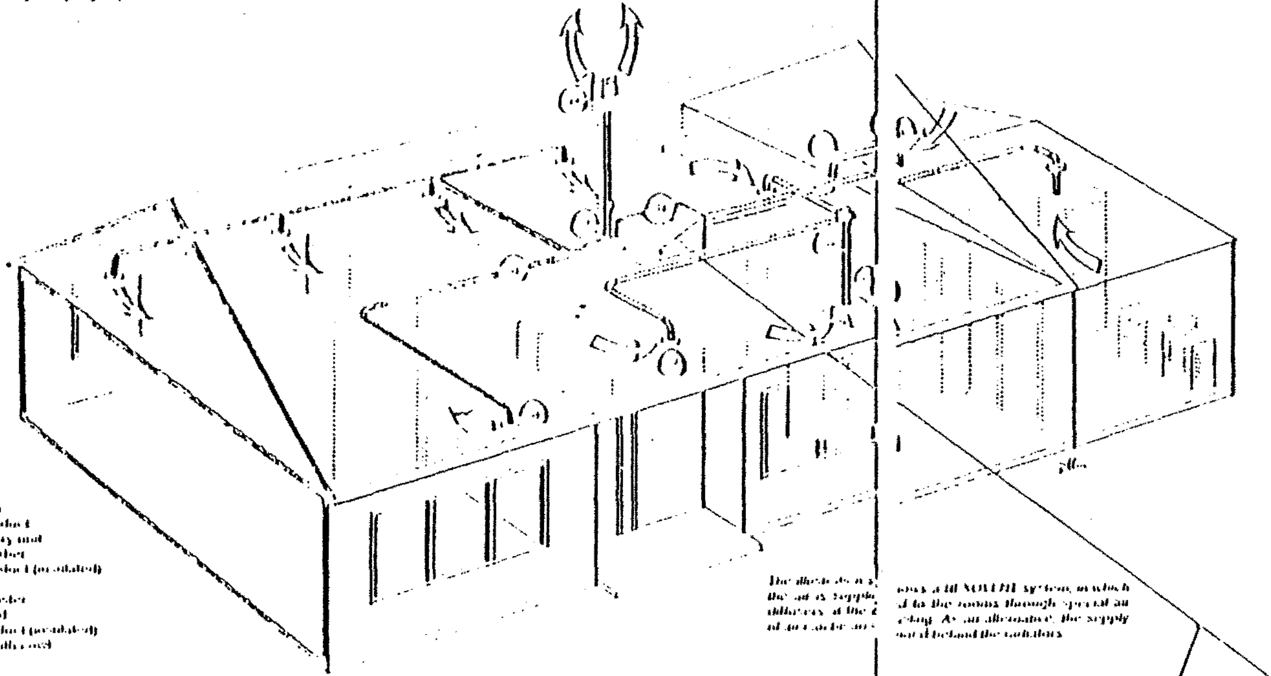
The capacity of the electrical heating element is 2 x 500 W, stepwise switching by 2 thermostats.

The canal heating element is fitted with security thermostat. The canal heating element is available with other capacities.

VMC GENVEX UNIT is connected to 200 V/J, 6 or 10 A, dependent on the capacity of the heating element.

REXOVENT – a complete system for heat recovery and ventilation

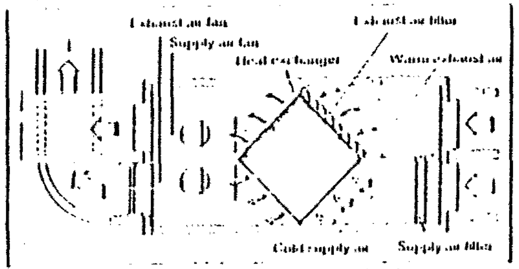
The system is delivered as a package. All components are standardized, thus appreciably simplifying the installation work.



1 Louvre grille
2 Outdoor air duct
3 Heat recovery unit
4 Sound absorber
5 Distribution duct (insulated)
6 Air diffuser
7 Exhaust register
8 Cooker hood
9 Exhaust air duct (insulated)
10 Hood duct [illegible]

The illustration shows a REXOVENT system, in which the air is supplied to the rooms through special air diffusers at the ceiling. As an alternative, the supply air can be [illegible] behind the radiators.

High efficiency heat recovery unit with separate supply and exhaust air ducts



Diagrammatic arrangement of the heat recovery unit

The heat recovery unit is the core of the REXOVENT system. The unit is compact and lightweight and is easy to install. The supply and exhaust air fans are of centrifugal type and can be wired for single-speed or two-speed operation or can be equipped with variable thyristor speed controllers. The filters, heat exchanger and fans are easily accessible for inspection and cleaning.

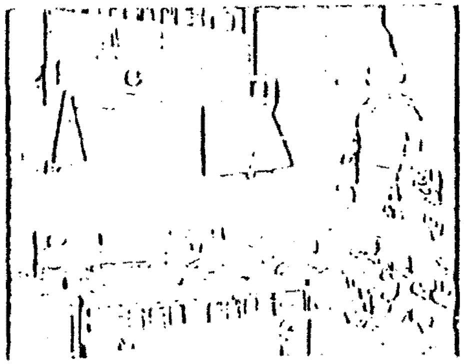
The heat exchanger is of the cross flow type. It consists of cross laid flat and corrugated aluminium strips. This arrangement provides a large number of passages through which the supply and exhaust air flow along completely separate paths.

In view of the very high efficiency of the heat exchanger, frosting may occur in the exhaust air passages of the exchanger at low outdoor temperatures. Variants of the unit are therefore available for different climatic zones, and automatic defrosting by electric heating or by electric heating combined with briefly reduced supply air flow is provided.

The efficient [illegible] heat recovery unit reduces appreciably the cost of energy and is thus an extremely profitable investment.

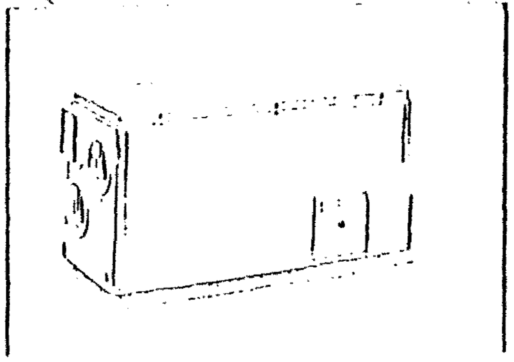
The air diffusers [illegible] provide a constant and stable supply of ventilation air.

The cooker hood has a large volume and thus efficiently extracts cooking odours at a low air flow.



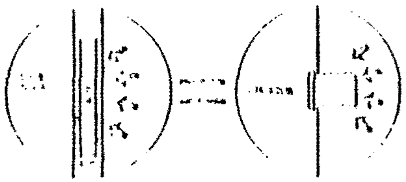
The heat recovery unit occupies little space and is easy to install.

The heat recovery unit is insulated on the outside. It is compact (1000 mm long, 400 mm wide and 300 mm high) and weighs no more than 17 kg.



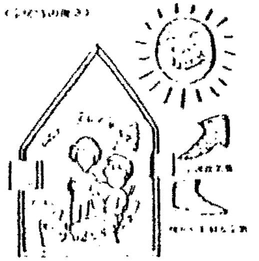
音をシャットアウト！

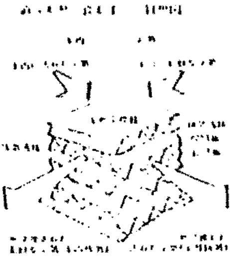
[illegible]

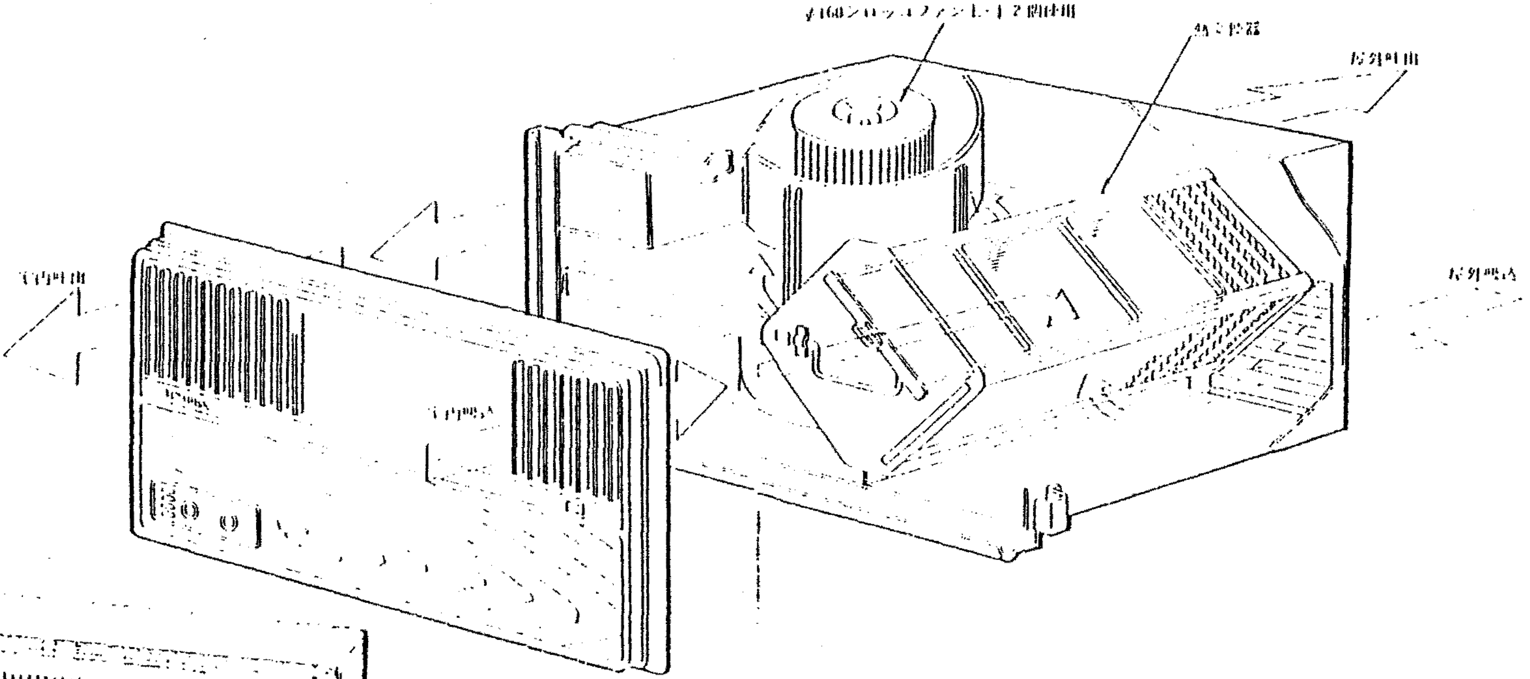


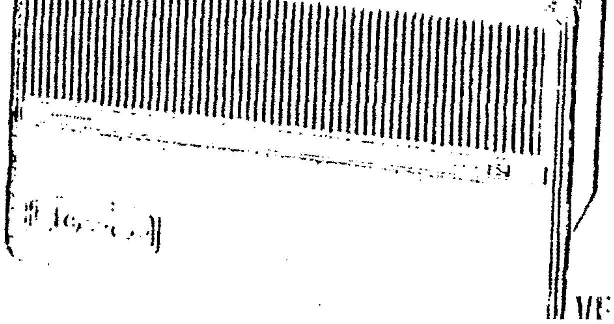
暑さ(寒さ)をシャットアウト！

[illegible]







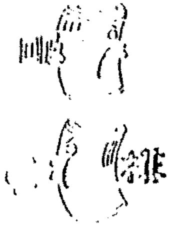


VEF-16M

経済換気

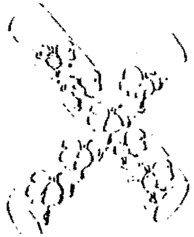
[illegible]

安定換気



[illegible]

清潔換気



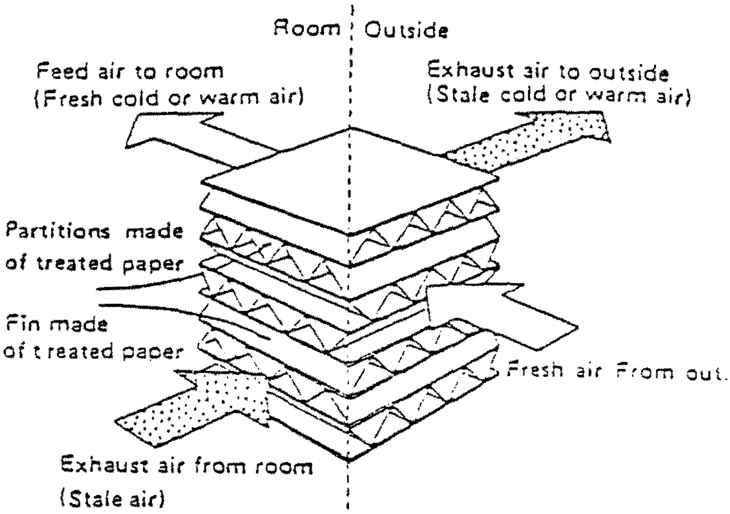
[illegible]

LOSSNAY

1. CONSTRUCTION AND PRINCIPLE

1.1 Construction

Lossnay is a cross-flow total heat exchanger constructed of plates and fins made of treated paper. The fresh air and exhaust air passages are totally separated, allowing the fresh air to be preconditioned to the temperature and humidity levels of the room air without mixing with the exhaust air.



1.2 Principle

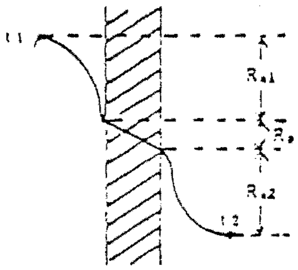
Lossnay's principle of operation is based on the heat transfer properties and moisture permeability of treated paper. Total heat (sensible heat plus latent heat) is transferred to the fresh air being introduced into the system via the medium of treated paper. This principle is easy to understand if you conduct this simple experiment:

Roll a sheet of paper into a tube and blow through it. Your hand holding the paper will immediately feel warm. If cold air was blown through the paper, your hand would feel cool. Thus, heat is readily transferred via a paper medium.

1.3 . Total Heat Exchanging Mechanism

(1) **Sensible heat exchange**

Sensible heat is transferred from higher to lower levels of the element. Although paper is usually regarded as a heat insulating material, it exhibits as far as gas-to-gas phases are concerned, a high thermal conductivity comparable to copper and aluminum (a 3% maximum thermal conductivity difference).



$$R_{a1} + R_{a2} \gg R_p$$

(2) **Latent heat exchange**

Latent heat is transferred from higher to lower levels of the element because of partial pressure differences. Capillarity caused by condensation on the element is not always a prerequisite to latent heat exchange and the element is not always moistened even under highly humid conditions. Energy is released when condensation occurs and gained after the osmosis.