ECONOMIZER HISTORY

Introduction

An economizer is a system of controls and dampers used on commercial air conditioning units to reduce energy costs by using outdoor air for "free cooling" whenever possible. Economizers have been around for over 30 years.

What is less well known is the way in which economizer systems have improved, due to the impact of better control strategies and sensors.

This brief paper summarizes the evolution of economizer systems, including:

- System description
- History
- Glossary of key terms
- Graphics
  —typical economizer
  —economizer/control evolution

System Description

A typical economizer is shown in Fig. 1. It consists of an actuator linked to the outdoor air and return air dampers. The linkage is set so that as the actuator opens one damper, it proportionately closes the other.

In the cooling mode the economizer and its controls act to use outdoor air (if it is suitable for cooling) before "mechanical" cooling (air conditioning units) is started.

The economizer actuator is controlled by a mixed air temperature sensor located in the mixture of return and outdoor air. An outdoor air changeover control is used as a high limit; if the outdoor air becomes too warm and/or humid (i.e.; is no longer able to cool the building) the changeover control signals the actuator to return the outdoor air damper to the minimum ventilation position.

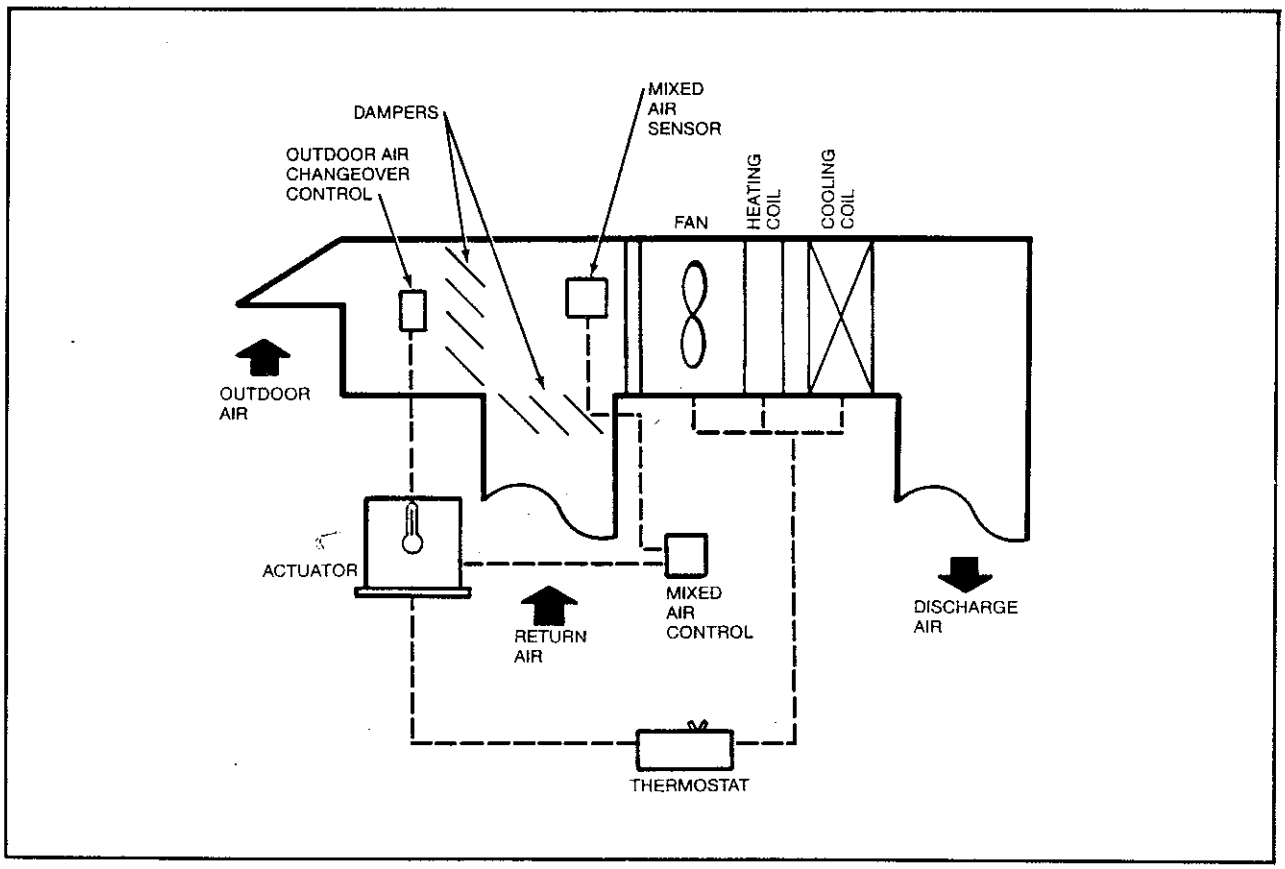

Fig. 1—Typical (integrated) economizer.

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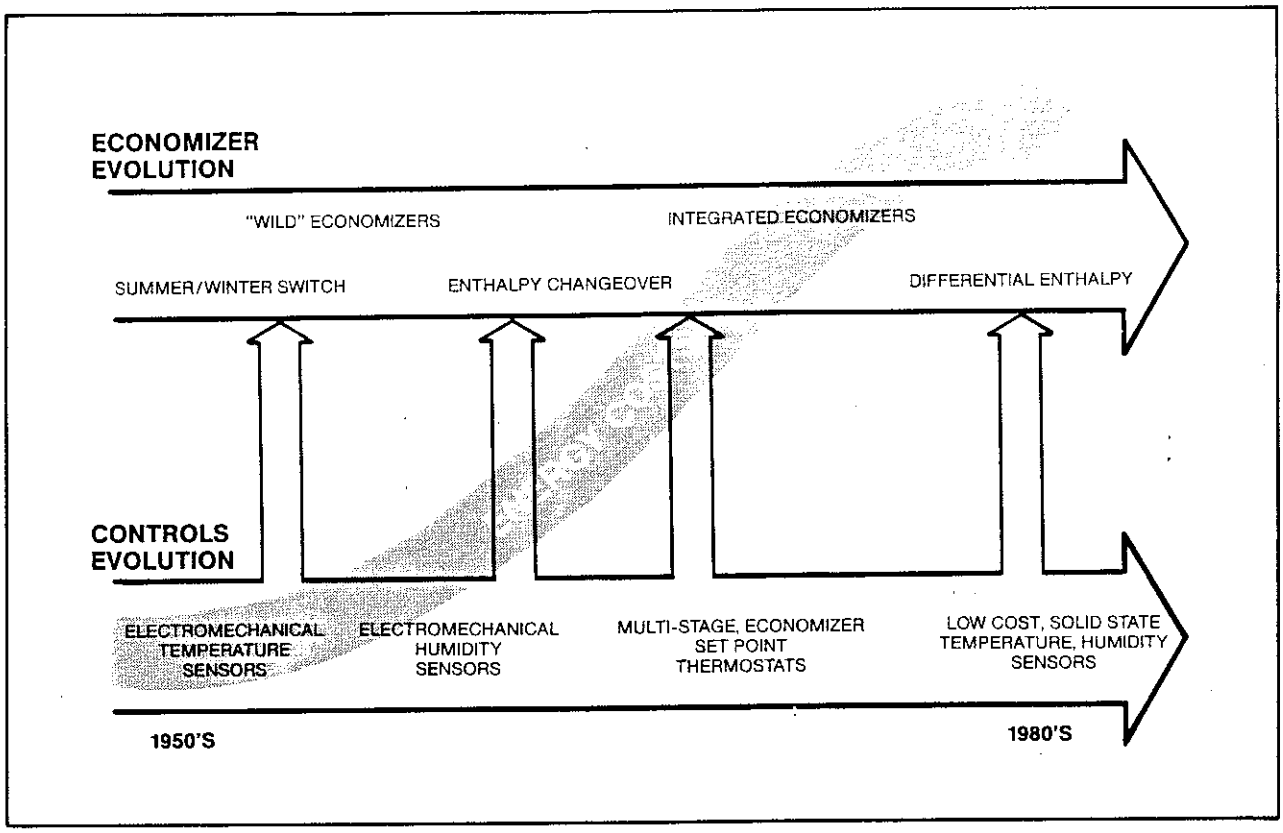

Fig. 2—Evolution of economizer/control systems.

History

1950s

Early economizers used increased outdoor air whenever it was below around 55 F to help maintain the 55-60 F mixed air temperature to the building. While this produced substantial savings during the cooling season, the summer-winter switch (used to de-activate the option for outdoor air) was often forgotten in the summer position resulting in increased winter heating costs. Such operation is termed "wild economizer" by the industry.

> Example: In Chicago, with a wild economizer the increase in heating cost was twice the economizer savings on cooling costs in the summer.

Enthalpy-based electronic economizer systems existed, but costs limited acceptability primarily to larger installations.

Early 1970s

Changeover controls based upon low-cost electromechanical enthalpy sensors using nylon elements are introduced. While the decision to use outdoor air for free cooling has improved through the use of combined temperature and humidity information, the "wild" economizer still predominates and summer cooling savings are frequently lost during the heating season.

Mid 1970s

Rising energy costs helped to introduce the "integrated" economizer — one in which outdoor air is used to control mixed air temperature *only when cooling is required in the building.* Achieved through interconnection of the changeover control with heating-cooling thermostats, control systems were offered by the industry for both single and multizone systems. Examples are Honeywell W973 and W936 controllers. Electromechanical temperature and humidity sensors are still most common.

Early 1980s

Fully integrated thermostat/changeover controls are introduced. Honeywell T7400/W7400 is an example—a multistage, seven-day programmable thermostat with separate set point for economizer changeover.

Mid 1980s
Low-cost solid state humidity sensors, combined with thermistor temperature sensors, make low-cost, high-accuracy, high-stability enthalpy sensors a reality for owners of smaller buildings.

In addition to improving the performance of integrated economizers with changeover control based upon outdoor air enthalpy, the sensor costs permit the use of a *second* enthalpy sensor in the return air duct to truly optimize the decision of which air source to use for the first stage of cooling. Termed "differential" enthalpy control by the industry, such changeover controls can double the savings vs. single sensor controls.

Glossary

Changeover Control — The controls which "change over" from outside air for "free" cooling (when it is suitable for the purpose) to return air, and vice versa.

Differential Enthalpy — A changeover control with enthalpy sensors in *both* the outdoor and return air ducts. The control can thus choose the *lowest* enthalpy air source for cooling, rather than outdoor air only when below a fixed enthalpy set point. Maximized savings of cooling energy.

Discharge Air — Air that is delivered to the space which has been mixed and heated or cooled.

Economizer — A control and damper arrangement applied to an air conditioning unit for the purpose of reducing energy costs by using outdoor air for cooling whenever possible (see Fig. 1).

Enthalpy — A measure of the total energy content of air based both upon temperature and moisture content. When selecting air for cooling, it is a better measurement than temperature alone. With single sensor, outdoor air for free cooling is selected when its enthalpy is below a selected set point.

Integrated Economizer — Eliminates potential energy-wasting characteristic of "wild" economizer by enabling the outdoor air for "free" cooling function *only* on call for cooling from thermostat.

Mixed Air — The combination of outdoor and return air before it is mechanically heated or cooled.

Mixed Air Control — A control which attempts to maintain the combination of outdoor and return air at in a range suitable for free cooling (usually 55-60 F) before mechanical cooling is employed.

"Wild" Economizer — An actuator/damper system with controls that permit the introduction of increased outdoor air, whether cooling is required or not. Can result in increased heating season energy costs.