May 2, 1967 E. K. HARLEY, JR 3,316,733

MUFFLERS

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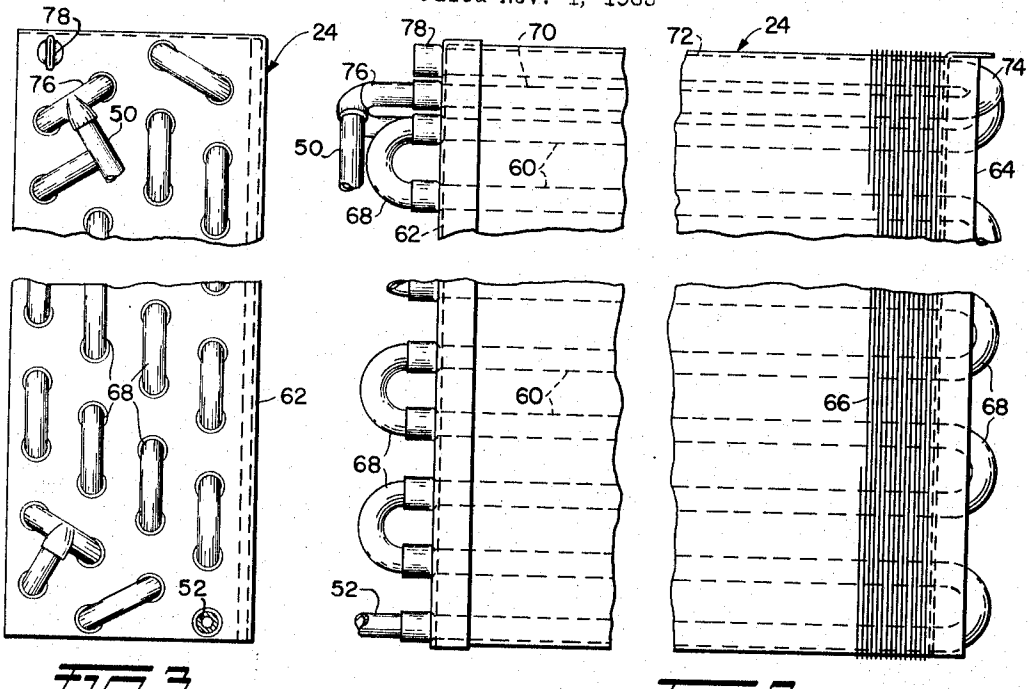


FIG. 3

FIG. 2

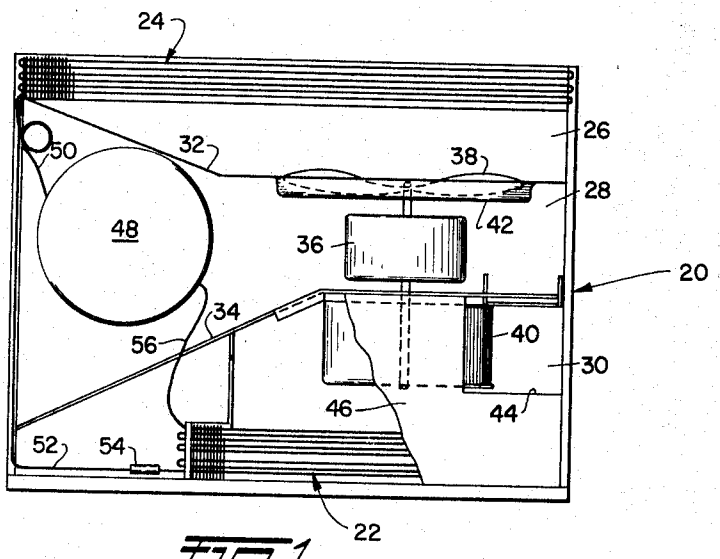


FIG. 1

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This invention relates to air conditioning apparatus and more particularly to improved mufflers for use with the compressors incorporated in such apparatus.

Over the years, continuing efforts have been made to reduce the noise produced by air conditioners, particularly window air conditioners which are often located within a few feet of the occupants of a room. Considerable progress has been made in blower design, in the use of insulation and in the construction of louvers to reduce the noise produced by the movement of air through the unit.

Efforts to reduce the noise produced by the refrigerant compressor have also met with some success. Although there is some noise attributable to the compressor motor, this is generally of an unobtrusive low-level high-frequency character. In a typical case most of the audible compressor noise is attributable to the low-frequency pulsation developed by the discharge gases.

The gas delivered by the compressor through the compressor discharge tube to the condenser does not flow steadily since the compressor is of reciprocating design. The pulses of gas delivered by the compressor are a source of noise since the compressor pulsations cause variations in the gas pressure in the condenser with the result that the entire condenser may act as a sound source. An internal muffler inside the compressor is only partially effective in eliminating this objectionable noise. While reasonably effective mufflers are available, they are either too bulky or too expensive to warrant their use in compact low cost refrigeration equipment such as window air conditioning units and refrigerators.

With these considerations in mind, it is the principal purpose and object of the present invention to provide improved mufflers for refrigerant compressors which provide effective dampening of the low-frequency pulsations produced by such compressors and which are of mechanically uncomplicated and low cost construction.

It is a further object of the present invention to provide improved mufflers for refrigerant compressors which do not increase the weight or size of the air conditioning system.

It is an additional object of the present invention to provide improved refrigerant compressor mufflers which utilize a portion of the existing condenser as the muffler and thus do not require extra parts.

Additional objects and advantages will become apparent as the description proceeds in connection with the accompanying drawings in which:

FIGURE 1 is a semi-diagrammatic top plan view of a typical window air conditioner unit incorporating the muffler of the present invention;

FIGURE 2 is an enlarged front elevation of the condenser muffler assembly of the present invention; and

FIGURE 3 is an end elevation of the unit illustrated in FIGURE 2.

Referring now more particularly to the drawings, FIGURE 1 illustrates a typical window air conditioner unit to which the present invention has particular application. All of the components of the air conditioner unit are enclosed in a housing **20**, the forward portion containing the evaporator assembly **22** being adapted to project through a window opening. A condenser assembly **24**, described in detail below, extends across the rear of the unit.

The assembly is divided into rear, intermediate, and forward compartments **26**, **28** and **30**, respectively, by vertical walls **32** and **34**. A single drive motor **36**, mounted in the intermediate compartment, operates blowers **38** and **40**, the former drawing air in through louvers not shown in the side walls of the intermediate compartment **28** and delivering it through an opening **42** in the wall **32** for passage over the condenser coil **24** to the outside atmosphere. The blower **40** normally draws air from the room over the evaporator coil **22** and delivers it through an opening **44** in a horizontal wall **46** for return to the room through an opening provided in the air conditioner front panel, not shown.

The motor-compressor assembly **48**, positioned in the intermediate compartment **28**, delivers compressed refrigerant through a conduit **50** to the condenser assembly **24** in a manner described in detail below. After passage through the condenser coil **24**, the condensed refrigerant flows through a conduit **52** and an expansion valve or capillary **54** to the evaporator coil **22**. After passage through the coil **22**, the gaseous refrigerant is returned to the inlet side of the compressor through a suction line **56**. Except for the condenser assembly **24**, described below, the air conditioner unit illustrated in FIGURE 1 is of essentially conventional construction and accordingly will not be described further.

Referring now to FIGURES 2 and 3, the main body of the condenser assembly is of essentially conventional construction and comprises a series of tubes **60** extending horizontally across the assembly between end plates **62** and **64**. The tubes **60** are provided with fins **66** in the usual manner. The ends of the tubes are connected by short return bend tubes **68** in such a manner that the refrigerant flows in series through all of the tubes in a single pass from the inlet, connected to the compressor discharge line **50**, to the outlet, connected to the conduit **52** leading to the expansion valve and the evaporator assembly **22**.

In accordance with the present invention, the condenser assembly is provided with a self-contained muffler comprising a pair of tubes **70** and **72** extending between the end walls **62** and **64** and series-connected adjacent the wall **64** by a U-tube **74**. The opposite end of the tube **70** is connected by a fitting **76** to the compressor discharge line **50** and to the condenser tubes **60**. The corresponding end of the tube **72** is capped as at **78**. Thus, the components **70**, **72**, **74**, **76**, and **78**, form a closed column connected to the discharge side of the compressor in parallel with the main body of the condenser assembly.

While the trapped column comprises two of the tubes **70** and **72**, the number of tubes may be varied to provide a longer or shorter column to meet the needs of a particular installation. In a typical case the muffler column, comprising two tubes as illustrated provides a column length of approximately 45 inches.

At the time of installation the entire refrigerant system, including the condenser assembly, is charged with refrigerant in the normal manner. During the charging process the column formed by the tubes **70**, **72** and **74**, is filled with refrigerant gas.

The operation of the air conditioning assembly as a whole and the flow of refrigerant is entirely conventional. Actual experience has demonstrated, however, that the trapped column of refrigerant gas effectively absorbs and dampens the pulsations produced by the compressor and substantially reduces the pressure variations occurring within the condenser assembly with a consequent substantial reduction in the audible low frequency sound experienced in prior units.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respect as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. In refrigeration apparatus having a compressor and a condenser to which compressed refrigerant is delivered by the compressor through a discharge conduit; a muffler for said compressor comprising means forming a closed column connected to said discharge conduit in parallel with said condenser.

2. The apparatus according to claim 1 wherein said condenser comprises a plurality of series-connected condenser tubes, support structure mounting said tubes in spaced essentially parallel relation, and said muffler comprises at least one additional tube mounted on said support structure in essentially parallel relation with said condenser tubes.

3. The apparatus according to claim 1 wherein said condenser comprises a plurality of series-connected tubes forming a through pass from an inlet connected to said discharge conduit to an outlet, support structure mounting said condenser tubes in spaced essentially parallel relation and said muffler comprises at least one additional tube mounted on said support structure in essentially parallel relation with said condenser tubes, and means connecting said additional tube to said discharge conduit closely adjacent said inlet.

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