March 5, 1957 R. D. BLUM 2,783,979

INDUCTION UNIT FOR AIR CONDITIONING

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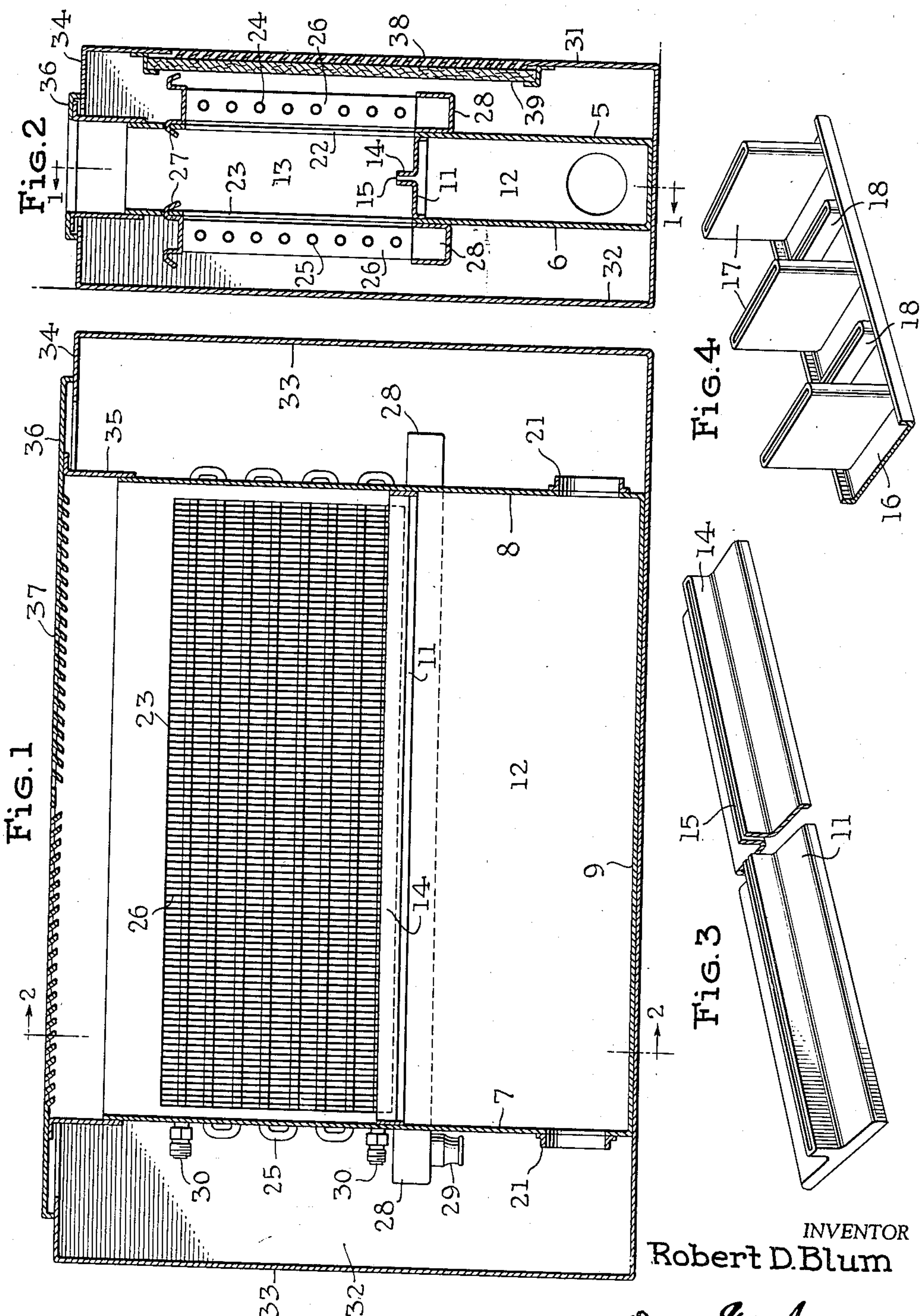

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FIG.6

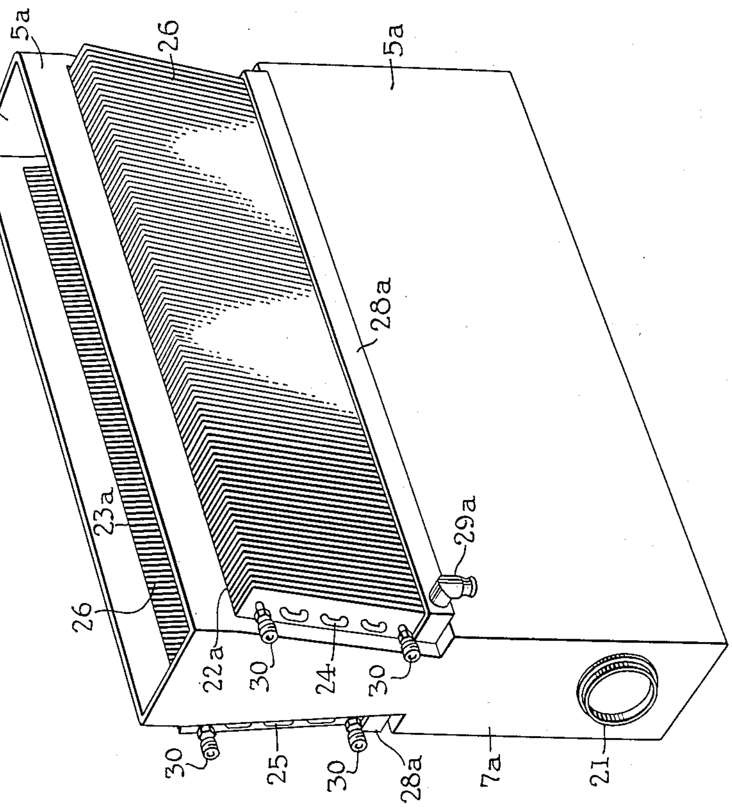
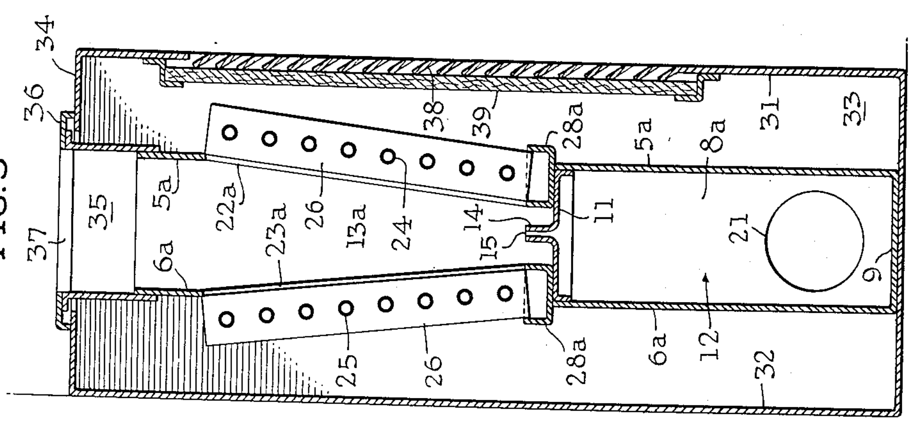


FIG.5



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INDUCTION UNIT FOR AIR CONDITIONING

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Application March 2, 1955, Serial No. 491,578

7 Claims. (Cl. 257—137)

This invention relates to heating, ventilating and air conditioning, and particularly to room units containing a heat exchanger and jet means operated by what is called "primary air" and serving to induce a flow of room air, called "secondary air," into heat exchanging contact with the heat exchanger.

The inductive heat exchanger of the prior art is customarily a finned flat coil extending across an entrance opening leading to the interior of the unit through its front. The secondary air enters the unit, exchanging heat with the coil and then mixes with the primary air within the unit. The resulting mixture flows back to the room usually through the top of the unit.

The advantages of such a unit are comparative silence, simplicity of construction and the facts that the primary air is sufficient in quantity for ventilation and may be conditioned at a central plant and distributed to the various units through duct work.

The disadvantages encountered heretofore are poor inductive effect (low ratio of secondary air to primary air) and unsatisfactory heat exchange. Attempts at improvement involving changed spacing of fins, or use of two superposed coils with fins in common (either or both) have not solved the problem. They had no significant effect. Improved nozzle arrangements have been tried, but only one (devised by this applicant) is known to make significant improvement, and there is a demand for something even better.

The whole trend of the art has been and still is to keep the unit low, so it can be set under any window, and shallow so it would not project far into the room. Added capacity had to be attained by increasing length with corresponding increase in consumption of primary air.

Applicant discovered that by discharging the primary air through a slot nozzle, or a plurality of nozzles into a narrow space between two spaced and rather thin finned coils, and so that the resulting jet stream or streams approximately bisected the interval between the coils, he could greatly improve performance. The coils may be parallel, or they may be splayed outward with reference to the direction of primary air flow. The use of two coils accounts for the major portion of the gain, and the splayed arrangement for a minor portion. Thus two parallel coils would be preferred when space considerations are paramount. The splayed arrangement would be used when the utmost performance is desired.

The rear coil must be spaced from the wall to afford an entrance path for the secondary air. As successfully used, the coils are only one tube deep in the direction of secondary air flow. They can be adequately finned and can have about twice the total effective surface used in prior art units.

Remembering that doubling the surface in the old single side constructions led to no significant improvement, the fact that the new symmetric construction with two thin coils greatly improves heat exchange and by improving the efficiency of the nozzle markedly raises the ratio of secondary to primary air, is truly remarkable, and is contrary to the indications afforded by prior tests.

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This improved action is traceable to at least two causes. Two substantially equal streams of secondary air enter in nearly opposite directions and merge with the primary air jet or jets, so that the merging flows have a symmetrical pattern which inherently tends to center the merged stream between the opposed exchangers. There is consequently less frictional retardation of the merged stream as it flows between the finned exchangers and less tendency to dissipate energy in eddying.

The secondary air derives propulsive energy from both sides of the propulsive jet so that a larger proportion of the jet energy is effectively applied and so that the tendency to cause eddying is less. This is easier to appreciate where the nozzle is a long slot discharging a sheet of air which bisects the interval between the heat exchange coils, but the effect is not limited to this type of nozzle. Every jet stream has at least two opposite sides, and the invention renders both effective.

By using two thin coils set parallel instead of one coil as heretofore, and by carefully choosing the interval between the proximate faces of the fins (into which interval the nozzles discharge) it is possible to hold the total thickness of the double sided coil unit to former single side dimensions, so that the only necessary increase is the small interval needed behind the rear coil to afford an inlet path for secondary air flowing to the rear coil. Where the angle between the two coils is moderate, the splayed coil arrangement is nearly as compact and the entrance path to the rear coil is better.

Since the rear coil is comparatively inaccessible, an entrance filter for all secondary air is considered necessary but the improvement in inductive effect is much more than enough to overcome the resistance offered by commercially available filters. The use of throw-away filters simplifies maintenance and prevents the generation of odors.

Several embodiments of the invention which are intended to be exemplary will now be described by reference to the accompanying drawings.

Figure 1 is a vertical longitudinal section on the line **1—1** of Figure 2, and showing a parallel coil arrangement.

Figure 2 is a vertical section on the line **2—2** of Figure 1.

Figure 3 is a perspective view of a nozzle plate having a single long nozzle slot.

Figure 4 is a perspective view of another type of nozzle plate.

Figure 5 is a view similar to Figure 2, but showing a splayed arrangement of the coils.

Figure 6 is a perspective of the unit shown in Figure 5 omitting the decorative casing.

Refer first to Figures 1–3.

The main housing of the unit is a rectangular shell having front and rear panels **5** and **6**, end panels **7** and **8** and a bottom **9**. The top is open. A nozzle plate **11** which is fixed in place divides a pressure plenum **12** from an induction space **13** and carries an upwardly directed nozzle **14** with a continuous discharge slot **15**.

Instead of the nozzle plate **14** it is practicable and often desirable to use a nozzle plate **16** such as is shown in Figure 4. This has a plurality of transverse nozzles diversified as to height, long nozzles **17** alternating with short nozzles **18**. All of the nozzles **17** and **18** are shown as of the elongated slot type and, as shown, the slots extend transversely. A conditioning unit of the single coil type having such nozzles is described and claimed in my application Serial No. 393,559, filed November 23, 1953, now abandoned.

The connections **21** are for supplying primary air to the plenum **12**. Either one of the connections **21** is plugged and the other is connected to a duct conveying primary air under suitable pressure.

This primary air discharging from slot **15** induces inward flow of room air through the inlet apertures **22** in front panel **5** and **23** in rear panel **6**. The air so entering exchanges heat with hot or cold heat exchange medium (water) flowing through flat coils **24** or **25** which are finned, as indicated at **26** and which overlie the openings **22** and **23**. Supply and discharge connections **30** for the coils are shown. The coils **24** and **25** may be connected in parallel with each other, or in series, in the water circuit of the conditioning system as engineering considerations may dictate.

The coils are suspended on the front and rear panels by slot-engaging flange-like hooks **27** and overlie drip troughs **28** intended to collect drip water which may condense from the air in summer. Drain connections for drip water are indicated at **29**.

The functional inductive unit, above described, is enclosed in an ornamental casing having a front **31**, back **32**, ends **33** and top **34**. The top **34** is apertured to receive a flanged tubular member **35**. The tubular portion of member **35** fits the upper end of the main housing and the flange **36** rests on top **34**.

The tubular member **35** leads air to the room and is provided with discharge louvers **37**. The front **31** of the ornamental casing is provided with louvers **38** practically from end to end. Since the ends **7** and **8** of the main housing and the front and back panels **5** and **6** thereof are spaced from the ends, front and back of the ornamental casing, room air entering through the louvers **38** can flow freely to openings **22** and **23**. A filter **39** is mounted behind the louvers to remove dust from the entering room air.

The modified form shown in Figures 5 and 6 is basically similar to the form shown in Figures 1 to 3 inclusive and for that reason it is possible to use the same reference numerals to designate the same parts. Thus, components which are unchanged are given the same reference numerals used in Figures 1 to 3. Where there are significant differences, the numeral is used with a subscript "*a*."

The pressure plenum **12** is essentially the same in the modified construction, but the induction space **13*a*** enlarges upwards. The nozzle plate **11** is essentially the same as that shown in Figures 2 and 3. The end plates **7*a*** and **8*a*** are given a flared configuration in their upper portions. This is clearly apparent in Figure 6. The front and rear plates **5*a*** and **6*a*** are formed in two parts so offset that the upper parts which define the entrances **22*a*** and **23*a*** for secondary air have the desired flaring arrangement. The coils **24** and **25** are not materially changed and each has fins **26**. They are mounted against the outer faces of the upper portions of the plates **5*a*** and **6*a*** and conform dimensionally to the openings **22*a*** and **23*a***. The drip troughs **28*a*** overlie the marginal portions of the nozzle plate **11** as best shown in Figure 5 and have offset drain connections **29*a*** as best shown in Figure 6.

The decorative casing is not materially changed, but extends slightly further outward from the wall. The entrance louvers **38** and the filter **39** conform to the similarly numbered parts in Figure 2. The connections **30** for the heat exchange liquid are essentially the same as those shown in Figure 1. The two heat exchange coils may be connected up either in series or in parallel as engineering considerations may dictate.

While the single slot nozzle plate shown in Figure 5 is preferred, it is technically possible to use the type of nozzle shown in Figure 4 with the construction illustrated in Figures 5 and 6.

Thus four specifically different arrangements have been indicated, i. e. either of two specifically different coil arrangements with either of two specifically different forms of nozzle.

As stated, the embodiments above described are given as examples of the invention. Modifications within the scope of the claims are contemplated.

What is claimed is:

1. The combination of a generally rectangular enclosing casing having in each of two opposed faces an inlet aperture and in a third face an exit aperture; two flat heat exchange coils each substantially coextensive with and extending across a corresponding inlet aperture; said coils being spaced apart to afford an interval forming a flow path to said exit aperture; connections for circulating heat exchange medium through said coils; and means for directing flow-inducing air through said interval toward said exit aperture comprising nozzle means directed toward the exit aperture and mounted at that margin of said interval which is remote from the exit aperture; and connections for supplying air under pressure to said nozzle means.

2. The combination defined in claim 1 in which the coils are substantially parallel.

3. The combination defined in claim 1 in which the coils are at an acute dihedral angle to each other and the nozzle is substantially at the apex of said angle.

4. The combination defined in claim 1 in which the coils are at an acute dihedral angle to each other and the nozzle is substantially at the apex of said angle, and comprises means defining a slot which is parallel with said apex and serves to discharge the primary air in a plane sheet which substantially bisects said dihedral angle.

5. The combination of a generally rectangular enclosing casing having in each of two opposed faces an inlet aperture and in a third face an exit aperture, the entrance apertures being of similar proportions, and substantially equal in size; two flat heat exchange coils each substantially coextensive with and extending across a corresponding inlet aperture; said coils being substantially parallel and spaced apart to afford an interval forming a flow path to said exit aperture; connections for circulating heat exchange medium through said coils; and means for directing flow-inducing air through said interval toward said exit aperture, comprising a substantially continuous slot-nozzle coextensive in length with and positioned substantially at that margin of the interval which is opposite to said exit aperture, said nozzle being positioned to discharge along substantially the medial plane of said interval and toward said exit aperture; and connections for supplying air under pressure to said nozzle.

6. The combination of a generally rectangular enclosing casing having in each of two opposed faces an inlet aperture and in a third face an exit aperture; two flat heat exchange coils each substantially coextensive with and extending across a corresponding inlet aperture; said coils being spaced apart to afford an interval forming a flow path to said exit aperture; connections for circulating heat exchange medium through said coils; and means for directing flow-inducing air through said interval toward said exit aperture, comprising a manifold extending along that margin of said interval which is remote from said exit aperture; connections for supplying air under pressure to said manifold; and a plurality of parallel plate-like nozzles lying in planes normal to the flat coils, fed with air by the manifold, and extending toward said exit aperture for different distances measured from the manifold, said nozzles serving to direct flow-inducing air through said interval toward said exit aperture.

7. The combination defined in claim 6 in which short and relatively longer nozzles alternate so that their points of discharge are distributed over said interval.

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