Aug. 2, 1966 H. S. DORMITZER 3,263,749

COMPACT SPACE HEATING APPARATUS FOR USE WITH FORCED-FLOW
FLUID-MEDIUM HEATING SYSTEMS AND METHOD

Filed March 6, 1964 3 Sheets-Sheet 1

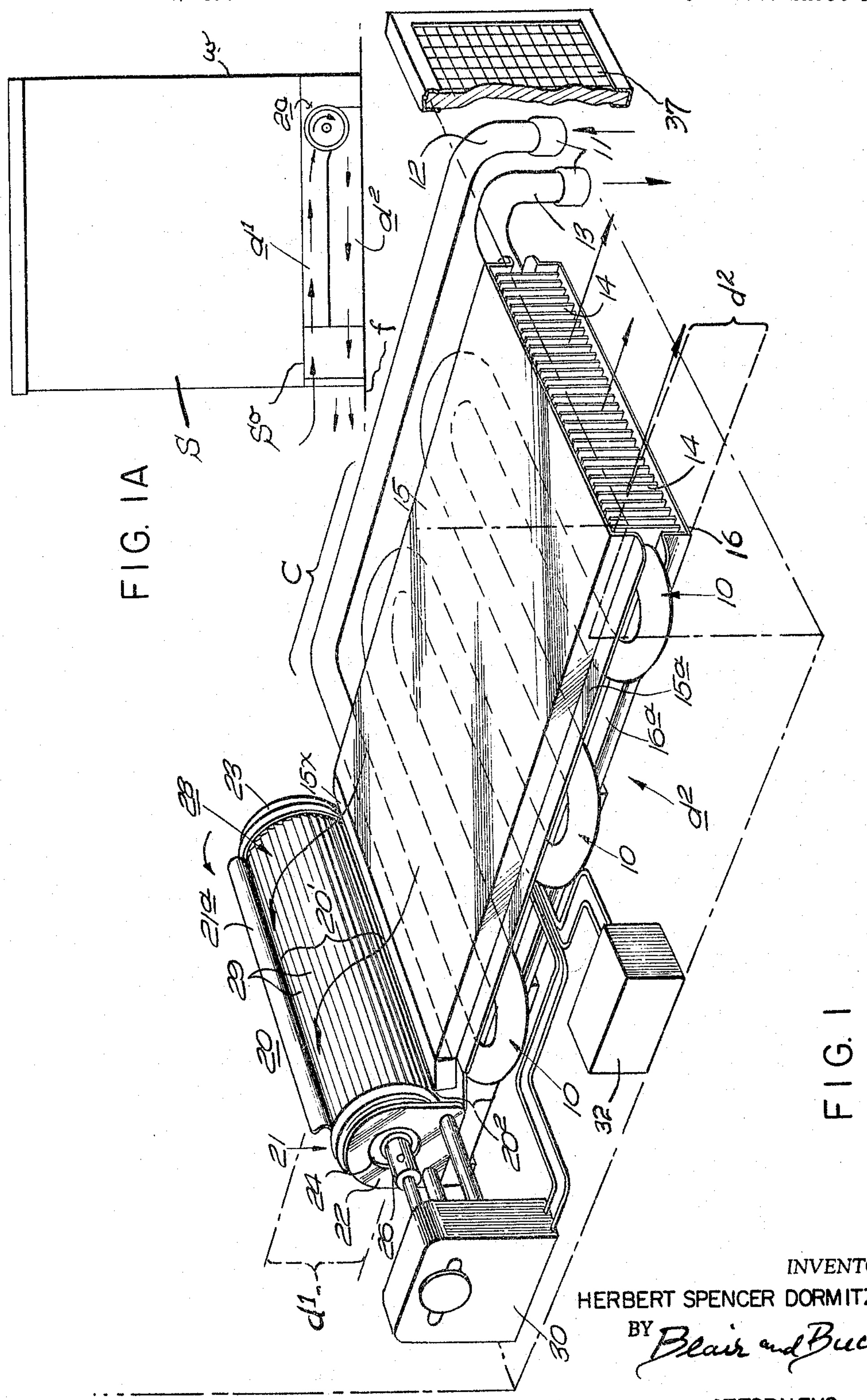

FIG. 1A

FIG. 1

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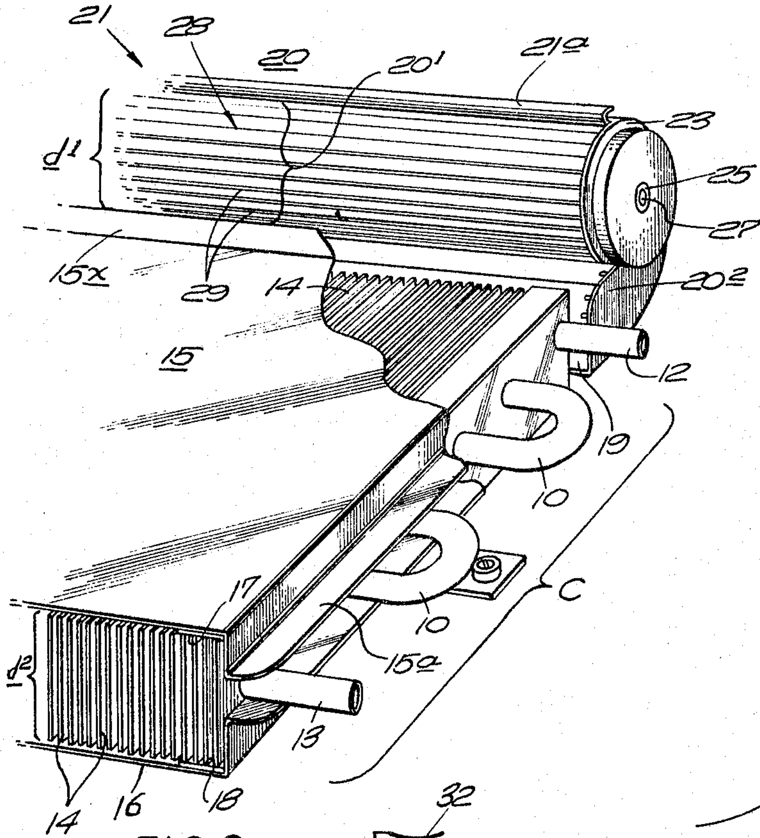

FIG. 2

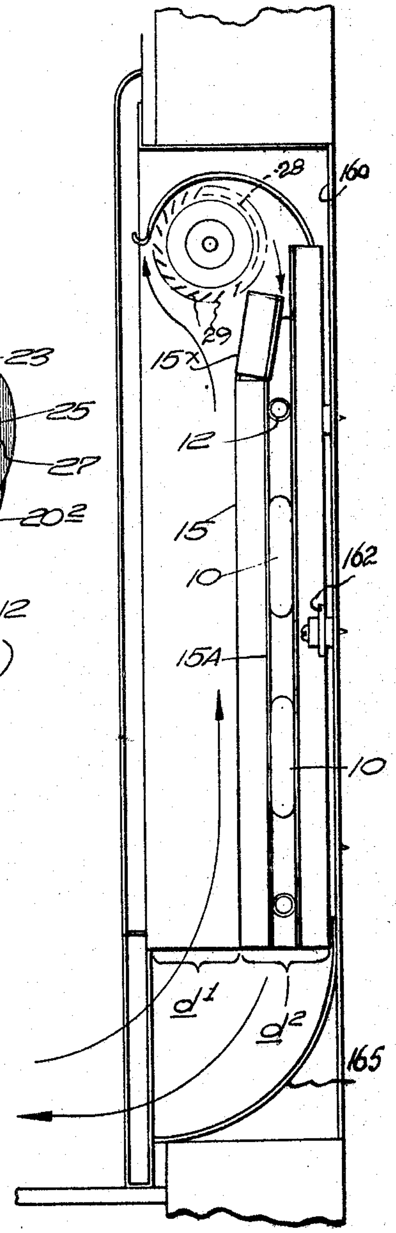

FIG. 4

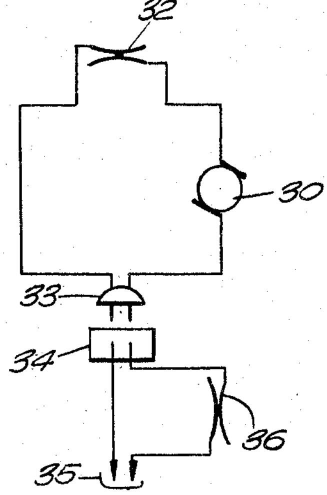

FIG. 5

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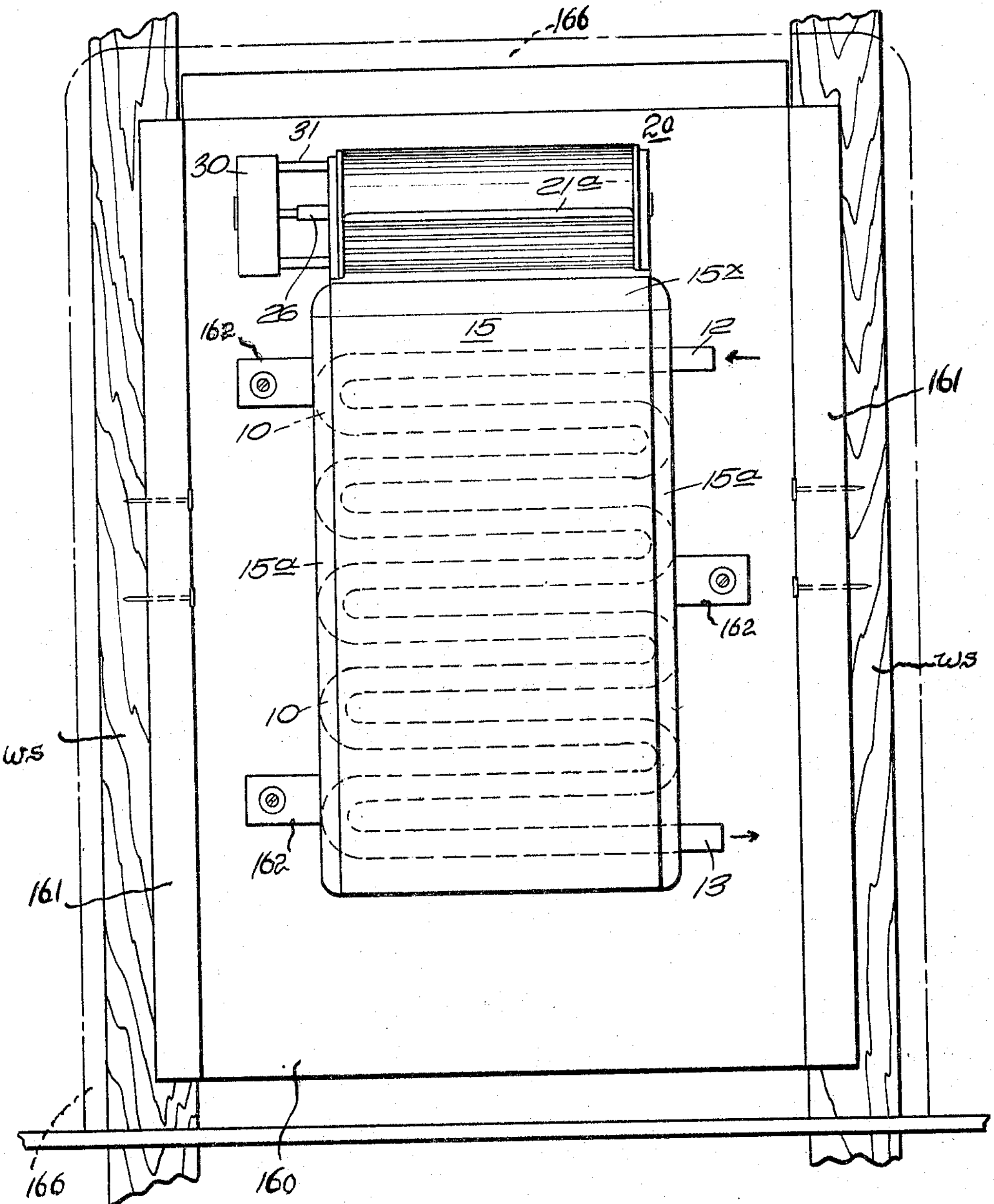

FIG. 3

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COMPACT SPACE HEATING APPARATUS FOR USE WITH FORCED-FLOW FLUID-MEDIUM HEATING SYSTEMS AND METHOD

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6 Claims. (Cl. 165—122)

My present invention relates to space heating. More particularly it aims to provide novel means and methods for utilizing available circulated fluid heating media of house and building heating systems, especially forced-flow hot water systems, for furnishing additional, or the entire, space heating requirements for rooms such as household kitchens and other locations where floor-supported cabinets and other equipment of counter height or greater leave a minimum of low-level free wall area for the placement of conventional radiation devices.

In accordance with the invention certain otherwise unoccupied floor and lower inner wall areas of restricted dimensions and volume are availed of for the installation of special heat exchange means peculiarly adapted to receive inflow of cool air at or adjacent floor level, to impart heat gain to it and to reversely return a paralleling flow of warm air adequate for the room heating purposes. The restricted locational volumes concerned are those generally found below, behind or between kitchen cabinets and the like and having a longitudinal extent of about two feet or more, either horizontally along the floor toward and from the room wall or vertically with the room wall adjacent the floor. Such spaces are characterized by a shallow elongate oblong cross-section in the transverse plane at right angles to the length or air flow direction thereof.

One familiar example of such volume is the "toe space" of about 4 inches in height generally provided between the roof floor and the bottom of a kitchen cabinet, overhung by the latter at the front of the cabinet and extending beneath the latter back to the room wall. In such instance the oblong cross-section concerned is in the vertical plane, and the longitudinal dimension to be availed of for the air flow is horizontal, along the floor between the cabinet front and the room wall. Here the minor or shallow dimension of the oblong cross-section is vertical, and is limited by the depth of the below-cabinet toe-space.

Another example of a restricted space of oblong cross-section utilizable under the invention is that between adjacent studding members within the room wall and extending upward from or adjacent the floor, such as behind a more or less open cabinet or set of shelves or between two spaced apart cabinets. Here the longitudinal extent or air flow direction in the heater device is vertical, and the plane of the oblong cross-section concerned is horizontal, with the minor or shallow dimension limited by the depth of internal wall space between inner and outer vertical wall surfaces, again usually about 4 inches. As will be apparent from the following description in connection with the drawings the heat exchange units of the invention are adapted for operative accommodation in such restricted spaces either in a generally horizontal position, as in the below-cabinet toe-spaces, or in a generally upright or vertical position as within the wall interior.

For the purposes of description the terms "length" and "longitudinal" herein refer to the major dimension of the units, being the direction of the operative in and out flow of the air, whether in fact horizontal or vertical according to the place of installation. The shallow oblong cross-section area at right angles to said flow direction will similarly be understood as being in the vertical plane in the below-counter installation, or in the horizontal plane

in the inside-the-wall locations. In either instance the minor or shallow dimension of such oblong cross-section will be referred to as the "depth" of the unit, while the major dimension of said oblong cross-section will be called the "width" of the unit, i.e. the distance along the floor and paralleling the room wall from side to side of the cabinet in the under-cabinet case, or horizontally between the adjacent studdings in the within-wall installations.

It will be appreciated that such "depth" dimension is a major factor in the problem to which the invention is addressed and that the invention is largely resident in the creation of heat exchange means operable from the fluid heating medium at hand and capable of operative reception within spaces characterized by such depth limitation.

Thus a main objective of the invention is to provide space heating for kitchens and other rooms where free-standing wall space is at a premium, and to accomplish the same by taking advantage of hitherto neglected spaces deemed too restricted for utilization of the fluid medium of the heating system at hand. Under the invention this objective is attained with avoidance of resort to bulky inconvenient or dangerous space heating devices not integrated with the existing heating system and which necessarily must be placed in exposed locations likely to be obstructive to desired use of the room.

Other objectives and advantages will be apparent from the description in connection with the drawings, including the provision of air circulating means associated with a finned heater element operating on a cross-flow principle to generate uniform air flow and pressure over the entire axial extent of the finned surface, and the provision of more compact heater means having parallel contiguous in and out air-flow paths within a single duct-like enclosure, one or more walls of which may be constituted by floor or wall surface of the room being heated.

The invention accordingly comprises the features of construction, combination of elements, and arrangements of parts which will be exemplified in the construction hereinafter set forth in connection with the accompanying drawings, in which:

FIG. 1 is an assembly view in perspective of a preferred embodiment of the invention heater, in this instance in a horizontal or floor level installation;

FIG. 1A is a diagrammatic view further illustrating an operative use of the means such as that of FIG. 1;

FIG. 2 is a fragmentary view in perspective of the heater with parts broken away and showing the longitudinal flow-paralleling array of fins extending in the flow direction;

FIG. 3 is a front elevation of the heater as in a vertical or wall mounted installation;

FIG. 4 is a vertical sectional view of the device of FIG. 3; and

FIG. 5 is a wiring diagram of an automatic control circuit for the heater.

Over the useful life of residences and other structures designed for human occupancy and which are required to be heated for human comfort occasions arise for modifications or adaptations of the interior spaces of the structure which necessitate the installation of additional heating capacity.

In these and other situations including initial constructions heating problems occur where there is not sufficient free-standing or unobstructed wall space to allow the use of conventional radiation units of sufficient capacity to furnish the needed heat output. Typically, as earlier mentioned, the wall space is too much taken up by counter-type or floor-mounted cabinets, such as now commonly found in kitchens.

The problem here concerned cannot be practicably solved by resort to space heating devices not integrated with the existing heating plant and the installation of which must be in an exposed location or such as to obstruct or interfere with the desired use of the space. Hence in lieu thereof the present invention provides heater apparatus of a uniquely compact and efficient design and utilizing novel operating principles allowing out-of-the-way installations as under a cabinet or within a wall, whether during alterations in or during the original construction of a given home or other building.

Referring now to the exemplary embodiments of the drawings, the invention unit comprises an air heating element or core having a length of copper or other good heat conductive tubing **10** bent back upon itself in a series of reverse bends or loops and which may as herein be formed into U-turns spaced and connected by parallel straight transverse tubing lengths intermediate the same, FIGS. 1 to 3. The tubing **10** as shown extends in a common plane and to a given core width, the number of loops and parallel runs being modified according to the heating capacity desired and the longitudinal extent of the space available for installation of the core C defined by such tubing and the associated fin assemblage to be referred to. The ends of the tubing length **10** are run out to locations convenient to, and are provided with fittings **11** adapting them for connection to the supply and return lines **12, 13** respectively of a circulating fluid heating medium system, preferably a forced-flow hot water system, as assumed in the present views.

The heating element core C further comprises a multiplicity of closely spaced parallel metal fins **14**, FIGS. 1 and 2, of good heat conductive capacity, for example aluminum, and which are arranged for maximum contact with the tubing **10** and thereby for maximum radiation to the ambient atmosphere of the heat from the water transmitted to them through the tubing wall. To that end the fins **14** are of thin sheet metal, are disposed perpendicularly to the mentioned plane of the tubing **10** and also at right angles to the direction of the straight runs of the tubing and hence lengthwise of the core C as a whole, so as to parallel its longitudinal axis and the direction of air flow along it. In the core assemblage said longitudinal fins **14** are closely spaced in a multiplicity which embraces substantially the full extent of the tubing, as to both the length and the width of the core C.

In depth, in the direction of the shallow or minor dimension of the oblong cross-section of the core, that is, vertically in the instance of FIGS. 1 and 2, the fins **14** are proportioned to occupy at least the lower half of the calculated available operative depth for the given heater unit, see also FIG. 1A, and in effect to define the lower of two flatwise superposed strata or flow levels within the core installation space. These two ducts or duct portions are designated as d^1 and d^2, FIGS. 1 and 1A, for the open upper or inflow duct and the lower finned outflow duct respectively. It is to be noted that in the tubing and fin assembly of the flow-path or duct d^2 occupying the lower portion of the total shallow oblong cross-sectional heater space, the longitudinally extending fins **14** and the transverse runs of the tubing **10** are mutually disposed in intimate metal-to-metal contact with the tubing snugly received through aligned transverse apertures in the fins. For assurance of good heat-transfer engagement the tubing may be expanded into all-round contact with the margins of the fin apertures, which latter may be flanged and soldered or brazed to the tubing in known manner if desired.

The described tubing and fin assembly or core C of the heater unit within the outflow duct d^2 thereof are longitudinally enclosed for confinement of the airflow thereto. The enclosure means comprises a cover panel or plate **15** of thin sheet metal, in upper horizontal position in FIG. 1 and front vertical position in the FIG. 4 example. It extends the full length of the core and across the width of the assemblage of fins **14** and is downturned over the outer faces of the outermost fins **14** and reversely outward in flanges **15a** at the level of the projecting bends of the tubing **10**. The opposite longitudinal lower or inner wall of the core enclosure may for installations such as FIGS. 1 and 1A be constituted directly by the room floor itself. Desirably and as illustrated a matching bottom or inner panel or plate **16** is provided, with the longitudinal margins upturned at the sides of the outer fins **14** and outwardly flanged as at **16a** adjacent the tubing **10**. At the shallow sides of the core C the space between the opposed plate flanges **15a, 16a** may be closed by neoprene or other gasket strips **17, 18** apertured for passage of the tubing **10** through them and held in place as by the margins of the plates **15, 16**.

The heater device of the invention further comprises in combination with the core C and disposed at the open inner end thereof a rotary blower or impeller designated generally at **20** for creating an inflow of cool air along the length and width of the upper duct d^1 and reverse outflow of the air outwardly through the finned lower duct d^2 subject to cumulative transfer of heat thereto during its travel to and projection from the open outer end of said lower duct d^2. Under the invention such blower element is of the type known as cross-flow, i.e. the flow direction is perpendicular to the rotor axis, as in turbo devices known by the name "Mortier blower," an example of which is found in U.S. Patent 3,033,441 to Coester.

Such blower **20** herein comprises a generally cylindrical housing, scroll or shell **21** of an axial extent conforming to the width of the core C and having oppositely circularly dished end walls or shrouds **22, 23**. The dished portions of these end walls are provided with low friction bearings **24, 25** aligned transversely of the core and rotatably receiving the axially aligned end journals **26, 27** of the hollow cylindrical elongated cage-like turborotor or impeller element proper **28**. The latter cooperates with the closely surrounding housing **21** to create the cross flow as mentioned. It comprises a circumferential series of vanes **29** extending parallel to the rotor axis in equi-spaced array uninterruptedly across between the end walls **22, 23**. The respective ends of the vanes are extended into and shrouded by the circular margins of the oppositely dished end wall portions to promote the cross flow.

The housing shell **21** is open over a substantial arc of approximately 90° at the upper out-facing portion thereof and the housing end walls are proportioned and arranged to present said forwardly open shell portion at a level above the cover plate **15** of the core C and with the axis of impeller substantially in the plane of or slightly above said plate **15**. The lower forward portion of the housing shell **20** likewise is open, see particularly FIG. 1A, for offset exit flow of the air at the level of the lower duct portion d^2 and toward the forward outer end of the core C.

Closely adjacent the inner transverse end of the core cover **15** the transverse margin **15a** thereof is directed desirably at a slight downward incline into close substantially wiping proximity to the outer edges of the rotor vanes **29** as they sweep past it. Said transverse cover margin **15a** thus is adapted to serve as a divider or dam affording an effective seal or cut-off line as between the low-pressure intake side of the blower **20** at the level of the upper duct d^1 and the high-pressure or output side from which the cross-flowing air is outwardly impelled at the lower level of the finned duct d^2. The vanes **29** as shown are disposed tangentially to the circumference of the impeller and at an inclination to the radius so as to afford them a forward angle of rake for a scooping action whereby the incoming air at the upper duct level d^1 is entrained and carried along by the vanes in a circular path about the impeller axis inwardly and downwardly around the latter and thence outward through the finned lower duct d^2.

Thus it is apparent that the cross-flow turbo-element or blower **20** is operatively coupled to the inner end of the core C, with the transversely open intake portion **20^1** defining the low-pressure entrance thereto for air incoming over the entire width of the core C above the cover plate **15** thereof, and with the equally wide flat nozzle-like exit area **20^2** thereof in closed flow communication outwardly to the finned lower duct d^2. An efficiently partitioning seal as between the low pressure intake and the high pressure output sides of the blower is provided at the inner end margin **15*a*** of the core cover plate **15** as stated, and the connection between the blower exit port **20^2** and the inner end of the core C may include a conformant oblong resilient collar or connective and cushioning gasket as indicated at **19**, FIG. 2.

From the foregoing in connection with the drawings, noting also FIG. 4 as well as FIGS. 1 to 3, it will be understood that the elongate cylindrical angularly vaned open cage-form impeller rotor **28** is dimensioned and proportioned to have a close-running fit as to the transverse outer edges of the vanes with respect to the housing **21** and to the enclosant dished ends **22**, **23** thereof, and especially at the pressure-partitioning seal **15*x*** between the low and the high pressure sides. As the edges of the vanes **29** sweep, upwardly and rearwardly in the views, and past said pressure seal **15*x*** cool air all along the upper duct d^1 of the core C is drawn in at the wide, shallow intake port **20^1**, is carried along by the vanes **29** and propelled rearwardly, downwardly and then forwardly to the output port or nozzle **20^2** and into the inter-fin passages of the core C. The upper margin of the intake port **20^1** is further defined and the inward propulsion of the air assisted by a downwardly and rearwardly directed guide or deflector lip **21*a*** defining with the vanes themselves an intapering port. As an important feature of the invention the construction, arrangement and operation of the impeller and associated parts is such that the air is propelled with uniform force and at uniform pressure across the entire width of the housing **20** and of the heater core C and effectively along the full length of the latter.

The impeller **28** is rotatively driven at a relatively high speed, preferably of the order of from about 1050 upwards to 1800 r.p.m. or thereabouts. For this purpose the heater unit is provided with an electric motor **30** which may be a small fractional H.P. 115 volt 60 cycle A.C. unit as for example a di-pole shaded pole type of motor. As shown in FIG. 1 it is fixedly mounted with the heater unit, conveniently by positioning studs **31**, **31** joining the motor housing and the adjacent end wall **22** of the impeller housing **20**, at whichever end thereof is selected for the purpose.

Suitable electrical connections and control circuit for the heater unit are provided as indicated in part in FIG. 1 and diagrammatically in FIG. 5. The motor desirably is connected in series with a thermo-responsive switch **32** disposed to sense a heated status of the core C by reason of flow therein of the hot water or other fluid medium of the building heating system. Such switch **32** automatically closes when the core C is appropriately heated, and opens to prevent the device from blowing cold air at other times. Such thermostatically controlled motor circuit may be arranged for plug connection as indicated at **33**, FIG. 5, with an outlet **34** from a branch of the current supply line **35** which desirably is in turn subject to automatic control by a room thermostat **36**.

In FIG. 1 and schematically in FIG. 1A is shown a typical installation and location to which the hot water or other heating-fluid-supplied unit of the invention is uniquely suited, as earlier mentioned, namely, the space available below a conventional under-the-counter cabinet S, between the cabinet bottom wall and the floor *f* of the room, which most commonly is the kitchen. This below-cabinet space usually is enclosed at all but the front. The lateral and vertical dimensions are indicated in phantom in FIG. 1, and may be, for example, 14 inches wide by 24 inches long (front to rear) by 4 inches deep. In such space the heater is mounted horizontally with the blower **20** adjacent the room wall *w* and the open end of the pair of flatwise superposed air-flow ducts d^1, d^2 facing front.

Where the cabinet is pre-existing the invention unit may be connected up for heating without going through the bottom of the cabinet by bringing the hot water supply and return lines **12**, **13** through the kitchen floor at the toe-space or below the overhang S° at the cabinet front, FIGS. 1 and 2, and bringing out the ends of the tubing **10** for connection as by the fittings **11** to said hot water lines. At such locations the assembly or installation may be completed by a grille **37** removably set at the opening at the front margin of the toe-space overhang S°.

An alternative installation of the invention apparatus within the wall of a house is shown in FIGS. 3 and 4. In this instance a supplemental inner and here vertical hanger plate or apron **160** for the core is provided, dimensioned to extend beyond the sides of the core and formed with longitudinal flanges **161** adapted for reception against the securement as by nailing to the wall studding *ws*, with the main flat area of the apron set back in between adjacent studs, which are generally spaced 16 to 18 inches on centers. Thus the entirety of the heating unit is adapted to be located within the normal thickness of the wall, where a depth of about 4 in. usually is available. The finned core C and impeller assembly is hung on and supported vertically with and from such hanger apron **160** as by cushioned brackets **162** fixed to the core as at the longitudinal flanges **16*a*** thereof and to the apron. Thus the open inlet-outlet end of the core C and the twin parallel ducts d^1, d^2 thereof extend upwardly from a position spaced somewhat above the room floor *f*, providing for air ingress and outflow at or adjacent the floor level. Below the core the flow to and from it desirably is directed and assisted as by an arcuate baffle **165**, FIG. 4, adjacent the base of the room wall *w*.

The wall opening necessitated for such in-the-wall installation of the heater may be partially re-closed as by means of a panel of plasterboard or other surfacing to match the room wall. Alternatively the opening may have installed thereat a metal or other front panel preferably of a louvre or grille type as indicated in broken line at **166** in FIG. 3, and in full line on FIG. 4. As noted, the location of the heater device in the wall is sufficiently above the room floor for free flow of the air to and from the heater ducts d^1, d^2, assisted and directed in this instance by the guiding baffle or deflector **165**.

In operation the heater apparatus will automatically be activated in response to the signal of the room thermostat **36** provided the water in the tubing line **10** is hot enough to close the thermostatic switch **32** and allow the motor **30** to start up. The action of the rotor **28** and its elongate raked blades **29** is to circulate the air in and out of the heater enclosure along the elongate unidirectional shallow oblong cross-sectional ducts d^1, d^2. The cold air is drawn into the impeller housing **20** at the impeller inlet **20^1** and then accelerated to and through the impeller discharge nozzle **20^2** and under substantial positive pressure out through the core C in highly effective heat-gainful flow therefrom. It is particularly significant in the operative functioning of the heater that the turbo-impeller **20** is uniformly active across the entire width thereof between its rotatively mounted ends. Thus it develops and maintains a uniform pressure across the full width of the impeller housing **21**, over the entirety of which transverse extent paralleling the impeller axis it propels the air in a straight-line path of flow crosswise of said impeller axis, and with minimum restriction in its heat-gainful flow out between the elongate flow-paralleling fins **14** of the heater core C.

The improved construction and operation of the invention heating unit is distinguished further in that the location of the apparatus at floor height and for expelling of the hot air through the heating duct d^2 in a horizontal flow not only provides better comfort control, by the floor-level warm air flow, but also a better distribution pattern in that the floor is made to function in effect as one continuing closed side of the warm air duct.

In the development and practice of the invention various inherent factors are taken into consideration in the design and construction of the air-circulating space-heating means. These include the static pressure desired to be developed, the volume of air to be delivered in terms of cubic feet per minute, the appropriate impeller speed, and the power required to deliver the calculated volume of air to maintain the selected static pressure from a given drive speed. These variables involve such further considerations as restriction of noise to an acceptable level, the holding of the forced draft to not greater than a comfortable level, and the rate of air flow for a given length of heater core to allow for an efficient heat exchange. While the invention apparatus may be constructed in various lengths and widths, it will commonly be of a depth not to exceed the conventional height of toe-space or depth of wall enclosure, which under current domestic building practice is generally found to average about 4 in. Thus for the heater units as illustrated an average or most frequently appropriate dimensioning is found to be a depth of 4 in. with a width transversely across the fin assembly of 14 to 16 in. and a length in the flow direction lengthwise of the fins **14** of a minimum of about 22 to 24 in. With such proportioning and arrangement, it is found that a cross-flow impeller as shown and described having a diameter of 2.5 in. and driven at 1050 to 1100 r.p.m. will maintain a static pressure uniformly along the entire axial extent of the impeller such as to furnish under normal operation of the hot water heating system an outflow of comfortably heated air at the rate of 38 to 40 cu. ft. per minute per heater unit.

It will be understood that my invention, either as to means or method, is not limited to the exemplary embodiments or steps herein illustrated or described, and I set forth its scope in my following claims:

I claim:

1. In the space heating of rooms wherein free-standing wall area is limited as by wall cabinets having restricted toe-space between the bottom thereof and the room floor, for use in conjunction with the fluid heating medium of an available forced-flow heating system, a compact air-flow circulatory heater unit comprising a continuous serpentine length of heat radiative fluid-heating-medium conduit tubing disposed in a common plane in a plurality of transverse straight runs connected by U-bends and having the ends connectible to the heating medium supply and return lines respectively.

a multiplicity of elongated heat-conductive sheet metal fins in closely spaced parallelism and extending perpendicularly to the transverse runs of the tubing and with the latter passed through the fins at mid-depth thereof and in intimate heat transfer contact with them said common plane extending longitudinally of said fins,

said tubing and fins together defining a rectangular core of maximum longitudinal extent corresponding to the fin length and of shallow oblong cross-sectional form with the fins defining the restricted depth thereof,

cover plates spanning the top and bottom longitudinal margins of said fins and defining the top and bottom of an elongated flat, rectangular output duct open only at the ends, a blower element comprising a shell having a scroll-like cross-section mounted at one open end of and extending the full width of said output duct; said shell having an inlet opening extending the full width of and facing in the direction of and above said core and an outlet opening proportioned similarly as and in closed communication with said one open end of said output duct; said shell interiorily formed for smooth, unimpeded passage of an air flow into the full cross-sectional width and depth of said core; a rotor of the diameter and length closely conforming to the like dimensions of said shell and mounted therein for rotation about an axis paralleling the width of said core; a plurality of vanes on the periphery of said rotor and constructed and arranged to draw cool air from above the upper cover plate into said blower element and then to accelerate said air to and through said output duct with said air passing between the fins of said core, thereby heating the air and propelling it into a positive uniform outflow of warm air in a direction opposite to that of the cool air intake; and a motor for driving said rotor at a rate to produce the desired static pressure and forced flow of said warm air.

2. The heater unit according to claim **1** together with means defining a wall forming an inflow duct with said uppermost cover plate, and wherein said uppermost cover plate atop the multiplicity of fins separates the unit depthwise into said parallel inflow and outflow ducts respectively and the overall depth of the core and blower element is not more than that of a restricted sub-cabinet toe space at which the heater unit is to be operatively installed with said blower element end innermost.

3. The heater unit according to claim **1** including electric motor means carried thereby to drive said blower element, and associated thermo-responsive control means to energize the motor means only when the core is being warmed by a flow of fluid heating medium through the conduit tubing thereof.

4. In a compact, high output heating unit, a core structure comprising a length of tubing adapted to be coupled to the supply and return members of a forced-flow hot water heating system and extending in a given plane and in major extent longitudinally thereof, said tubing reversely bent in said plane for greater length of tubing per unit distance of extent in said direction, a plurality of similar parallel closely spaced heat radiating fins, said fins oriented normal to said plane and extending in said longitudinal direction, the fins embracing intimately said tubing and receiving therethrough the reverse bends of the tubing, panel elements engaged over the top and bottom longitudinal margins of said fins and defining with said core structure a wide flat shallow rectangular out-put duct open only at its ends; and blower means for forcing air through said heating element comprising a casing defining a chamber having an air inlet and an outlet communicating with one of said ends, with said air outlet aligned with and adjacent one open end of said rectangular heating element and said air inlet positioned above said one open end of said rectangular heating element and above said panel element engaged over the top margin of said fins, a rotor in said casing and extending the full width thereof, said rotor having vanes adapted to scoop air at the inlet and discharge it at the outlet of said chamber at uniform pressure over the full width of said opening for flow along and between the fins of said heating element, and a motor for driving said rotor.

5. In the space heating of rooms wherein free-standing wall area is limited by wall cabinets having an overhang forming a restricted toe-space between the bottom thereof and the room floor, for use in conjunction with the fluid heating medium of an available forced-flow heating system, the method which comprises the steps of inserting in said restricted space beneath said cabinets an elongate rectangular heat-transfer core of longitudinal fins and a serpentine conduit tubing extending therethrough in a horizontal plane with said core having a vertical depth including that of an impeller therefor not exceeding the depth of said space, rotating the impeller about an axis transverse to such depth direction and extending from side to side of the core, forcing an air flow crosswise of the impeller uniformly over the entire axial extent thereof, directing an inflow of relatively cool air inwardly to the impeller along and above the length of the core, and directing a reverse outflow of said air as a parallel substratum longitudinally outward along and between the fins of the core, supplying heat to said fins of the core whereby said air is heated, and then directing said heated air into the cabinet-containing room along the floor thereof.

6. A device as set forth in claim **1** wherein said cover

plates are provided with offset flanges along their side edges with said flanges parallel to one another and disposed on opposite sides and adjacent said U-bends.

References Cited by the Examiner

UNITED STATES PATENTS

1,914,197	6/1933	Davis et al.	165—53 X
2,008,255	7/1935	Larkin	237—12.3
2,207,776	7/1940	Black	126—110 X
3,035,760	5/1962	Simmons	165—122 X
3,147,368	9/1964	Walker	165—122 X
3,157,776	11/1964	Sohn et al.	165—53 X
3,200,609	8/1965	Laing	165—122 X

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