United States Patent

[11] 3,612,167

[72] Inventor **Leonard A. Bihler**
25 West 671 Jewell Road, Wheaton, Ill. 60187

[21] Appl. No. **801,378**
[22] Filed **Feb. 24, 1969**
[45] Patented **Oct. 12, 1971**

[54] **MULTIPLEX JOIST SYSTEM**
7 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **165/50,** 52/220
[51] **Int. Cl.** **F24f 3/00**
[50] **Field of Search** 165/49, 50, 53; 52/220

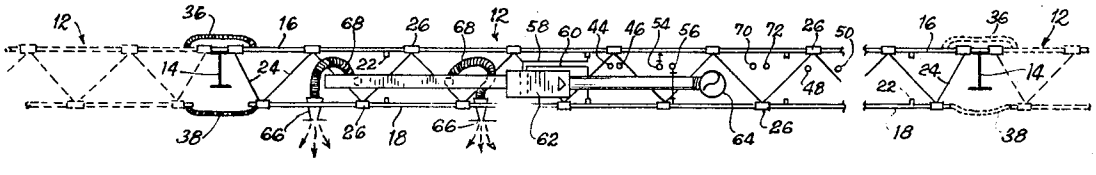
[56] **References Cited**

UNITED STATES PATENTS

2,425,775	8/1947	Yarborough	165/49
2,729,429	1/1956	Goemann	165/49
3,415,024	10/1968	Kotlarz	165/53

Primary Examiner—Charles Sukalo
Attorney—Burmeister, Palmatier & Hamby

ABSTRACT: The multiplex joist system comprises a series of spaced parallel joists, each having upper and lower hollow tubular chords with webbing therebetween. At regular intervals the hollow tubular chords of the joists are employed as branch supply and return conduits for the various fluids necessary to service the building, such as heating water, cooling water and chilled water. At regular intervals the hollow chords are also employed to carry electrical lines. One chord may be employed for power lines and the other for signal lines. Various utilization devices may be connected between the hollow tubular chords of the various joists so that the fluids will be circulated through such devices. The electrical lines are also connected to the utilization devices. At frequent intervals, the hollow tubular chords are provided with outlet fittings so that connections may be made at virtually any convenient location. The webbing may be in the form of a zigzag member connected to the tubular chords by means of clips which are welded to the chords and also to the webbing. In some cases, the zigzag member may be in the form of a hollow tube adapted to carry fluids.



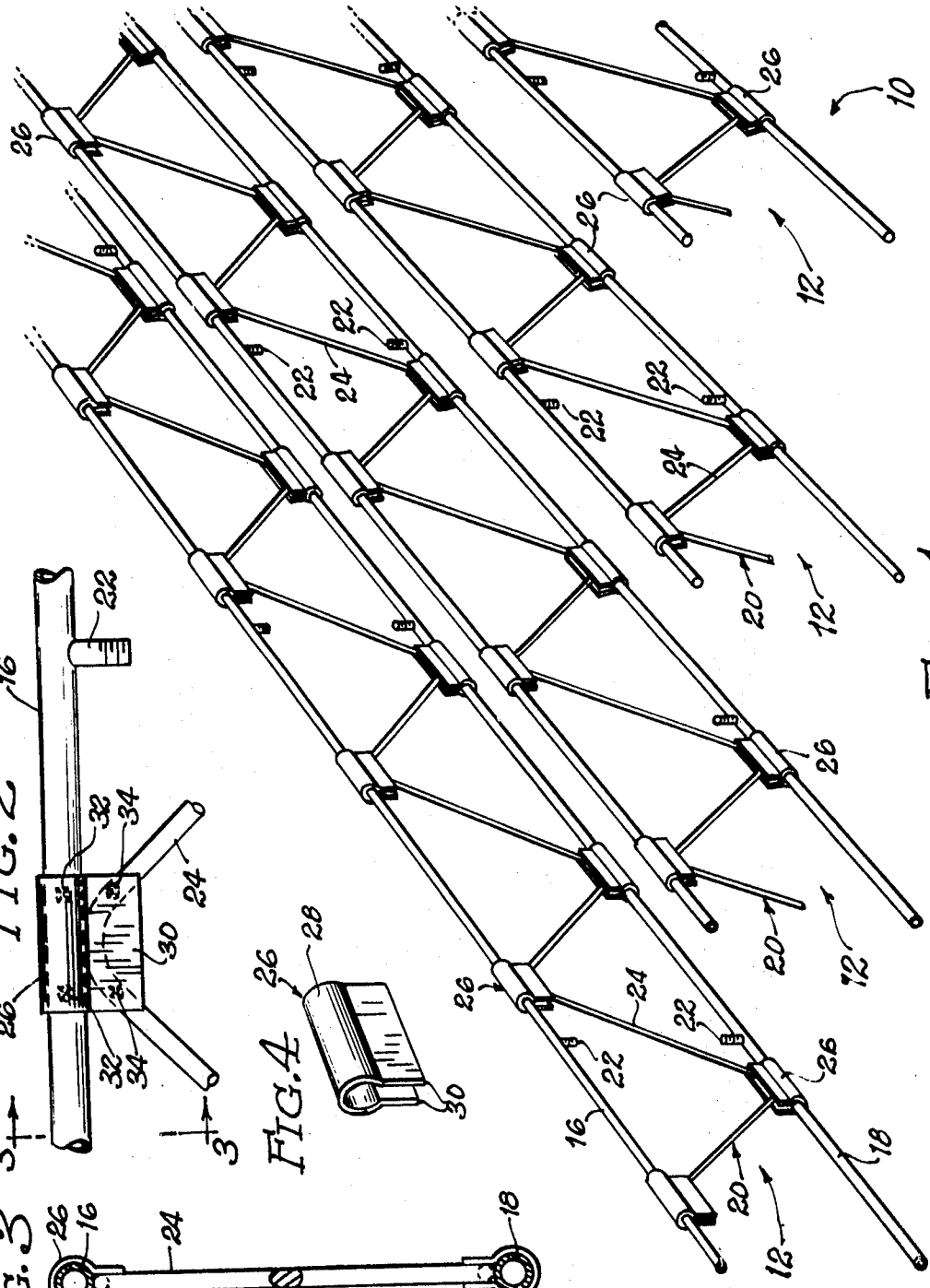


FIG. 1

FIG. 2

FIG. 4

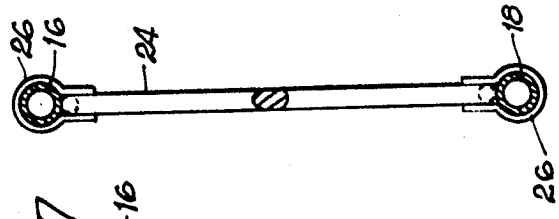


FIG. 3

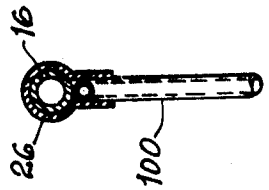


FIG. 7

INVENTOR
Leonard A. Bihler
by Burmeister, Palmatier
and Hamby Attys

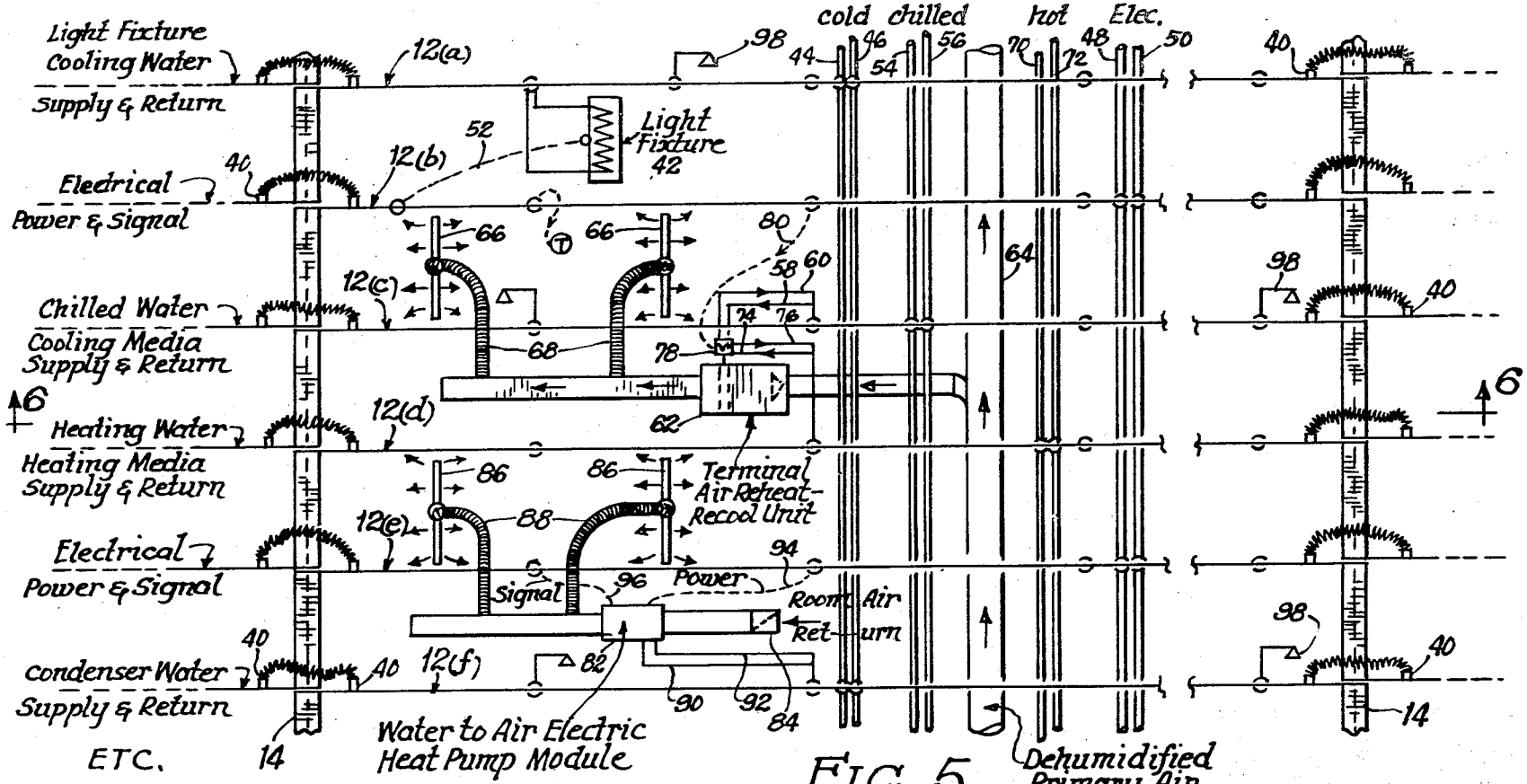

Light Fixture
Cooling Water
Supply & Return
Electrical
Power & Signal
Chilled Water
Cooling Media
Supply & Return
Heating Water
Heating Media
Supply & Return
Electrical
Power & Signal
Condenser Water
Supply & Return
ETC.
cold
chilled
hot
Elec.
Light Fixture
42
Terminal Air Reheat-Recool Unit
Signal
Power
Room Air Return
Water to Air Electric Heat Pump Module
Dehumidified Primary Air
12(a)
12(b)
12(c)
12(d)
12(e)
12(f)
14
40
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
80
82
84
86
88
90
92
94
96
98

FIG. 5

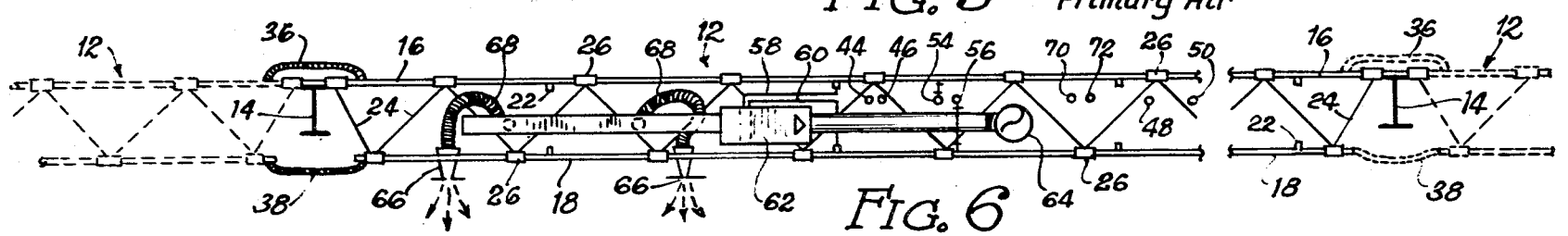

12
14
16
18
22
24
26
36
38
44
46
48
50
54
56
58
60
62
64
66
68
70
72

FIG. 6

MULTIPLEX JOIST SYSTEM

This invention relates to a multiplex joist system, which not only provides the usual support for ceilings and floors in a building, but also provides conduits for carrying various fluids and electrical wiring to all parts of the building.

It is known in the prior art to employ joists of the type having upper and lower chords with a webbing therebetween, which may be in the form of a zigzag rod. Joists of this kind are strong yet light in weight.

In accordance with the present invention, the joists not only serve the usual structural function, but also provide conduits for carrying necessary fluids to all parts of the building. The joists also carry electrical wiring for both power and signal functions. Thus, each joist has upper and lower chords in the form of hollow tubes, adapted to serve as conduits for fluids or electrical wiring. A series of the joists are spaced apart at regular intervals. The various necessary fluids are carried by the hollow tubular chords of the successive joists. Thus, the hollow tubular chords are employed as branch supply and return conduits for fluids such as heating water, cooling water and chilled water. At regular intervals, electrical lines are extended through the hollow tubular chords of one of the joists. One hollow chord may be employed for power lines, and the other for telephone, sound and other signal lines. At frequent intervals, the hollow tubular chords are provided with fittings which make it easy to connect utilization devices to the chords so that the various fluids will be circulated through the utilization devices. These utilization devices may comprise heating and cooling units, for example. The webbing of each joist preferably comprises a zigzag member which is secured to the chords by means of clips, welded to the chords and also to the zigzag member. In some case, these zigzag members may be in the form of a hollow tube adapted to carry cooling water or other fluids.

Further objects, advantages and features of the present invention will appear from the following description, taken with the accompanying drawings, in which:

FIG. 1 is a general perspective view, showing a multiplex joist system to be described as an illustrative embodiment of the present invention.

FIG. 2 is a fragmentary elevation of one of the joists.

FIG. 3 is a vertical section, taken through one of the joists, generally along the line 3—3 in FIG. 2.

FIG. 4 is a perspective view showing one of the clips, employed to connect the webbing to the tubular chords.

FIG. 5 is a diagrammatic plan view of the multiplex joist system.

FIG. 6 is a diagrammatic elevational section, taken generally along the line 6—6 in FIG. 5.

FIG. 7 is a fragmentary section, similar to a portion of FIG. 3, but showing a modified joist construction.

As just indicated, FIG. 1 illustrates a multiplex joist system 10 comprising a plurality of parallel joists 12, adapted to provide the usual structural support for a floor and ceiling of a building. The joists 12 are spaced apart, usually at regular intervals. As shown in FIGS. 5 and 6, the joists 12 normally extend between beams 14 which are parallel to each other but perpendicular to the joists.

Each joist 12 preferably comprises upper and lower chords 16 and 18, together with a webbing 20 connected therebetween. The upper and lower chords 16 and 18 are the main structural members of the joist 12. In accordance with the present invention, the upper and lower chords 16 and 18 also act as conduits to carry fluids or electrical wiring. Thus, the chords 16 and 18 are hollow and tubular in form, and preferably are made of standard metal pipe. Steel is the preferred material, but other metals may also be employed.

At frequent intervals, the hollow tubular chords 16 and 18 are preferably provided with tubular stubs or fittings 22 whereby fluid connections can easily be made to the chords. The stubs 22 are capped or otherwise closed when not used. Electrical wires may also be brought out of the hollow tubular chords 16 and 18 through the stubs 22.

The illustrated webbing 20 is skeletal in form and preferably comprises a continuous zigzag rod of member 24. However, a number of shorter diagonal members can also be employed.

The webbing 20 is securely connected to the hollow tubular chords 16 and 18. The webbing can be directly welded or it may be preferred to employ sleeves or clips 26 to facilitate the connection of the webbing 20 to the chords 16 and 18. As shown, the sleeves or clips 26 are welded to the zigzag webbing member 24 and also to the tubular chords 16 and 18.

As shown to best advantage in FIGS. 2–4 each clip 26 preferably comprises a generally cylindrical sleeve portion 28 which is wrapped part way around the corresponding chord 16 or 18. The sleeve portion 28 is formed with a pair of longitudinal flanges 30 which project laterally from the corresponding chord. The zigzag webbing rod or member 24 is tightly received between the flanges 30. As indicated in FIG. 2, welded joints 32 are preferably provided between the sleeve portion and the corresponding chord 16 or 18. Moreover, welded joints 34 are preferably provided between the zigzag webbing member 24 and the flanges 30. The construction of the clip or sleeve member 26 is such that it is easy to form the welded joints 32 and 34 by using an electrical resistance welding machine. Thus, the joists can be fabricated very quickly and economically.

The provision of the clips or sleeves 26 makes it possible to use standard steel pipe for the tubular chords 16 and 18. The use of such pipe provides adequate strength, as well as ample fluid carrying capacity and resistance to internal pressure.

As shown in FIGS. 5 and 6, the upper chords 16 of the joists 12 are usually supported on the upper sides of the beams 14. The upper chords may be welded or otherwise wise secured to the beams, if desired. Various connecting joints may also be employed. The beams may be either solid or similar in construction to the joists.

Normally, there are several beams 14, parallel to one another, and several spans of the joists 12, extending between the successive beams. The upper and lower chords 16 and 18 of each joist are normally connected to the upper and lower chords of the next joist in the adjacent span, so that the longitudinally aligned joists form continuous conduits for carrying the various fluids and electrical wiring. Various means may be employed to connect the ends of the chords together. As shown in FIGS. 5 and 6, it is preferred to employ upper and lower flexible metal conduits 36 and 38 between the ends of the successive upper and lower chords 16 and 18. For convenience, the flexible conduits 36 and 38 may be connected between side stubs 40 projecting from the chords 16 and 18. With this arrangement, the ends of the chords are capped or otherwise closed. As shown in FIG. 5, the end portions of the upper chords 16 may be overlapped where they rest upon the beams 14.

The successive joists 12 are preferably employed in sequence to handle the various fluids which need to be circulated throughout the building. One of the hollow chords 16 and 18 of each joist 12 may be employed as a supply conduit for a particular fluid, while the other chord is employed as a return conduit. At regular intervals, one of the joists 12 is also employed to carry electrical wiring. Power lines may be threaded through one of the hollow chords, while telephone and other signal lines are fed through the other chord.

The multiple applications of the joists 12 are illustrated by way of example in FIG. 5, in which the successive joists are designated 12(*a*), (*b*), (*c*), (*d*), (*e*) and (*f*). In this case, the upper and lower chords 16 and 18 of the first joist 12 (*a*) are employed as supply and return conduits for cool water, which may be used to cool light fixtures 42 or other utilization devices. It has been found that the heat generated by light fixtures is an important part of the air conditioning load of a typical building, and that cooling the light fixtures will reduce the cost of operating the air conditioning system. The chords 16 and 18 of the first joist 12(*a*) are connected to cold water supply and return pipes 44 and 46, extending transversely across the joist 12 and parallel to the beams 14.

The hollow chords 16 and 18 of the second joist 12(*b*) are employed to carry electrical power and signal lines. Thus, the chords are connected to electrical power and signal conduits 48 and 50, extending transversely to the joists. To illustrate the electrical wiring a arrangement, a branch conduit 52 is shown between the light fixture 42 and the upper chord 16 of the joist 12(*b*) in FIG. 5.

In this case, the upper and lower chords 16 and 18 of the third joist 12(*c*) are employed as supply and return conduits to carry chilled water for the air-conditioning system. Thus, the chords are connnected to supply and return pipes 54 and 56 for the chilled water. Branch pipes 58 and 60 are connected between the joist 12(*c*) and a terminal unit 62 adapted to reheat and recool the room air in the building. In addition to recirculating the room air, the terminal unit 62 receives outside air for ventilation purposes from a primary air duct 64, which supplies dehumidified primary air throughout the building. The use of dehumidified primary air throughout the building. The use of dehumidified primary air permits substantial cooling without condensation problems. Thus, there is no need to insulate the joists or provide condensate drains. The terminal unit 62 distributes the heated or cooled air to room outlets 66 through ducts 68.

As shown in FIG. 5, the fourth joist 12(*d*) is employed to circulate hot water for heating purposes. Thus, the upper and lower chords 16 and 18 of the joist 12(*d*) are connected to hot water supply and return pipes 70 and 72. The hot water is also supplied to the terminal unit 62, by means of branch pipes 74 and 76, extending between the terminal unit 62 and the joist 12(*d*). The terminal unit 62 preferably includes a thermostatic system for utilizing either the chilled water or the hot water, according to the temperature of the room air. Such system may include a control valve 78, operated by a suitable thermostat. The electrical wiring between the valve 78 and the thermostat may be fed through one of the hollow chords 16 and 18 of the joist 12(*b*), along with other signal wiring. As shown in FIG. 5, a brach electrical conduit 80 is connected between the valve 78 and the joist 12(*b*).

In FIG. 5, the fifth joist 12(*e*) is also employed to carry electrical wiring. The sixth joist 12(*f*) is utilized to circulate cooling water, which may be the same water circulated by the joist 12(*a*), or water from a different supply. As shown, the upper and lower chords 16 and 18 of the joist 12(*f*) are connected to the same supply and return pipes 44 and 46, as in the case of the joist 12(*a*), but a separate set of cold water pipes may be provided.

Another utilization device in the form of a heat pump 82 is supplied with water by the joist 12(*f*). It will be understood that the heat pump 82 is adapted to transfer heart from the water to the room air for heating purposes, or to transfer heat from the room air into the water for air conditioning purposes. The room air is drawn into the heat pump 82 through a duct 84 and is distributed to room outlets 86 through ducts 88. Branch supply and return pipes 90 and 92 are connected between the heat pump 82 and the joist 12(*f*). The electrical joist 12(*e*) may be employed to carry both the power lines and the thermostat lines for the heat pump 82. Thus, branch electrical conduits 94 and 96, for power and thermostatic lines, are connected between the heat pump 82 and the joist 12(*e*).

Rather than providing separate sprinkler pipes for fire protection, it is preferred to connect sprinkler heads 98 to the joists which supply the cooled water and the chilled water. Either type of water, or both types, may be employed. The sprinkler heads 98 are located as needed and are connected to the most convenient hollow chords of the appropriate joists. In FIG. 5 the sprinkler heads 98 are illustrated as being connected to the hollow chords of the joists 12(*a*), 12(*c*) and 12(*f*). It will be understood that the sprinkler heads are connected to the chords which serve as branch supply conduits for the cold or chilled water.

In the multiplex joist system of the present invention, the joists provide structural support for the floors and ceilings of the building. In addition, the hollow tubular upper and lower chords of the joists are employed as supply and return conduits for the various fluids to be distributed throughout the building. Such fluids may include hot water, cold water and chilled water. The successive joists are preferably arranged to carry different fluids, so that all of the necessary fluids will be conveniently available throughout all parts of the building. At intervals, the hollow chords of the joists are also employed to carry electrical power and signal lines.

FIG. 7 shows a modified construction in which the zigzag webbing member is in the form of a hollow tube or pipe 100, which may also be employed to carry various fluids, such as cooling water. Another advantageous arrangement is to employ the hollow webbing tubes 100 to provide fire protection.

It will be evident that the present invention results in considerable economies in the building construction because the multiplex joists take the place of most of the fluid piping and electrical conduits which are normally required. Furthermore, the multiplex joist system of the present invention insures that all necessary fluids and electrical wiring will be conveniently available throughout the building. In this way, room arrangements can be changed without any need for costly relocation of the fluid piping.

Various other modifications, terminal units alternative constructions and equivalents may be employed, as will be understood by those skilled in the art.

It is readily possible to prevent corrosion of the joists by the fluids which are circulated through the hollow tubular chords. Inasmuch as the fluids are constantly recirculated they soon lose their dissolved or entrained oxygen, so that the fluids become substantially noncorrosive. Moreover, corrosive effects may be inhibited very effectively by using appropriate additives in the circulating fluids. From the standpoint of corrosion control, it is much more advantageous to recirculate water and other fluids through the hollow chords of the joists, than to use the hollow chords for carrying hot or cold tap water, which tends to be noticeably corrosive.

I claim:

1. A multiplex joist system for building construction
comprising a series of horizontally spaced substantially parallel and horizontal joists,
each joist comprising generally horizontal upper and lower chords spaced apart vertically and with a metal webbing fixed therebetween,
said upper and lower chords being in the form of hollow metal tubes,
said chords and said webbing providing the structural strength and rigidity of said joists,
a system of supply and return pipes for circulating a fluid,
means for connecting said supply and return pipes to the chords of at least certain of said joists at spaced intervals whereby said chords are utilized as branch conduits for the fluid,
said supply pipe being connected to one chord of each such joist while the return pipe is connected to the other chord thereof,
each of said chords having a plurality of laterally projecting stub connecting devices for selectively establishing fluid carrying connections thereto,
and a utilization device connected between the upper and lower chords of at least one such joist whereby the fluid will be circulated through said utilization device,
said utilization device being connected to certain of said connecting devices.

2. A system according to claim 1,
in which said utilization device comprises means for circulating air through said device while utilizing the fluid to change the temperature of the air.

3. A system according to claim 1,
in which said utilization device comprise means utilizing said fluid to achieve a cooling effect.

4. A system according to claim 1,
including means utilizing said fluid to achieve a heating effect.

5. A system according to claim 1,

including electrical lines extending through the hollow tubular chords of certain of said joists.

6. A system according to claim 1,

including electrical lines extending through the hollow tubular chords of certain of said joists,

one chord of each such joist being utilized for electrical power lines while the other chord is utilized for electrical signal lines.

7. A system according to claim 1,

in which said webbing includes a hollow continuous tube for carrying fluids.