

July 5, 1927.

1,634,938

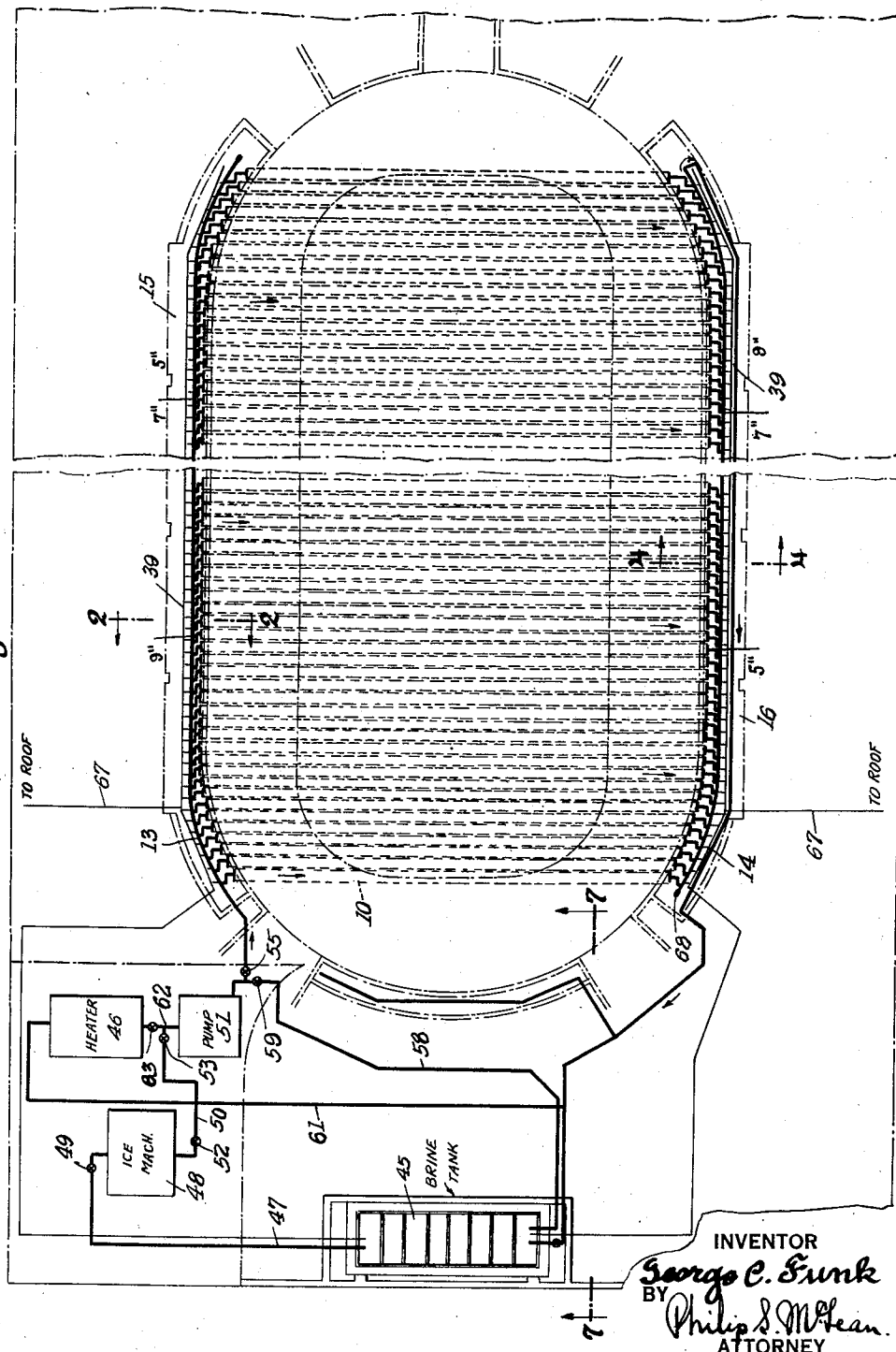
G. C. FUNK

ICE SKATING RINK

Filed Oct. 16, 1926

4 Sheets-Sheet 1

Fig. 1.



July 5, 1927.

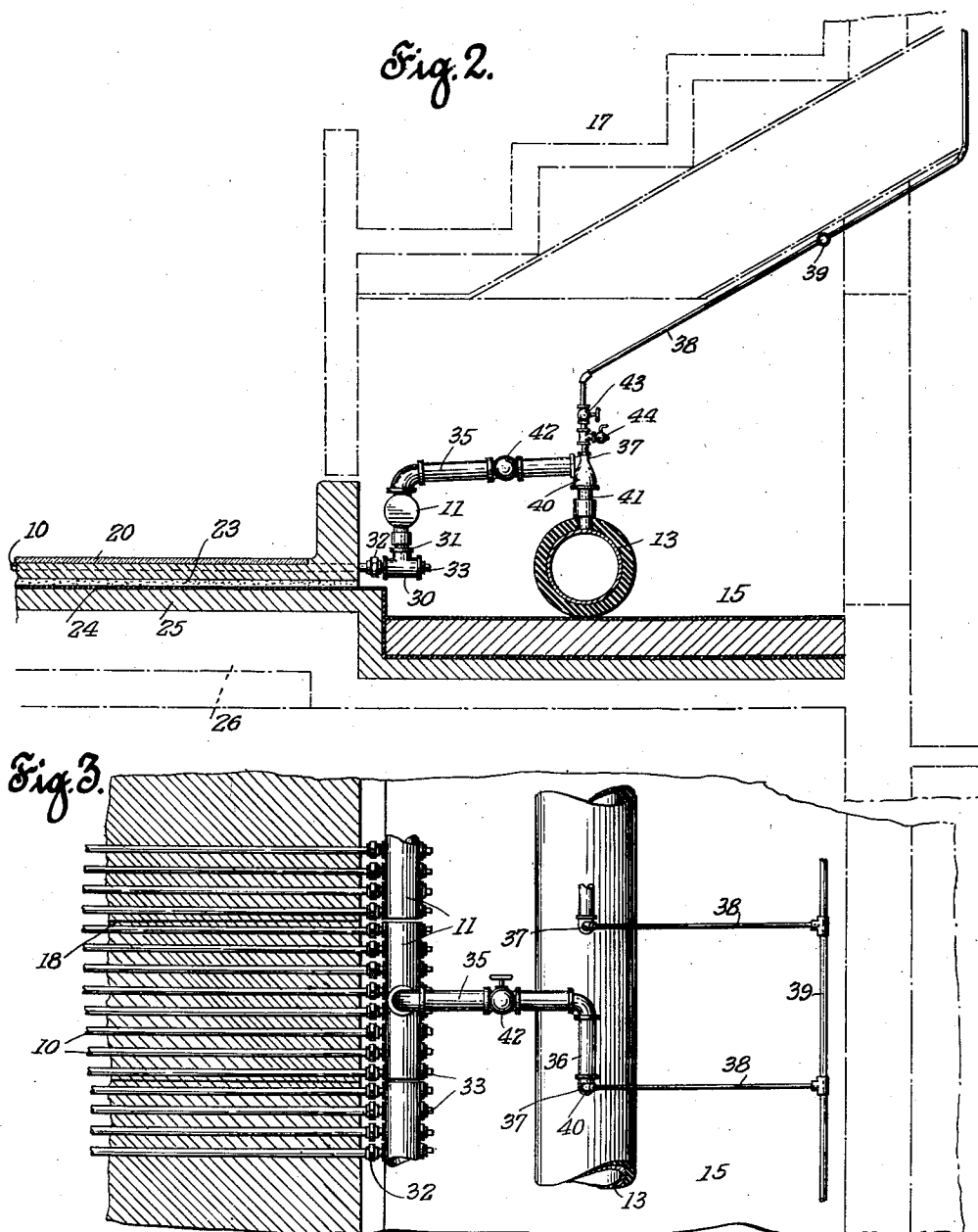
1,634,938

G. C. FUNK

ICE SKATING RINK

Filed Oct. 16, 1926

4 Sheets-Sheet 2



INVENTOR

George C. Funk

BY

Philip S. McJean.

ATTORNEY

July 5, 1927.

1,634,938

G. C. FUNK

ICE SKATING RINK

Filed Oct. 16, 1926

4 Sheets-Sheet 3

Fig. 4.

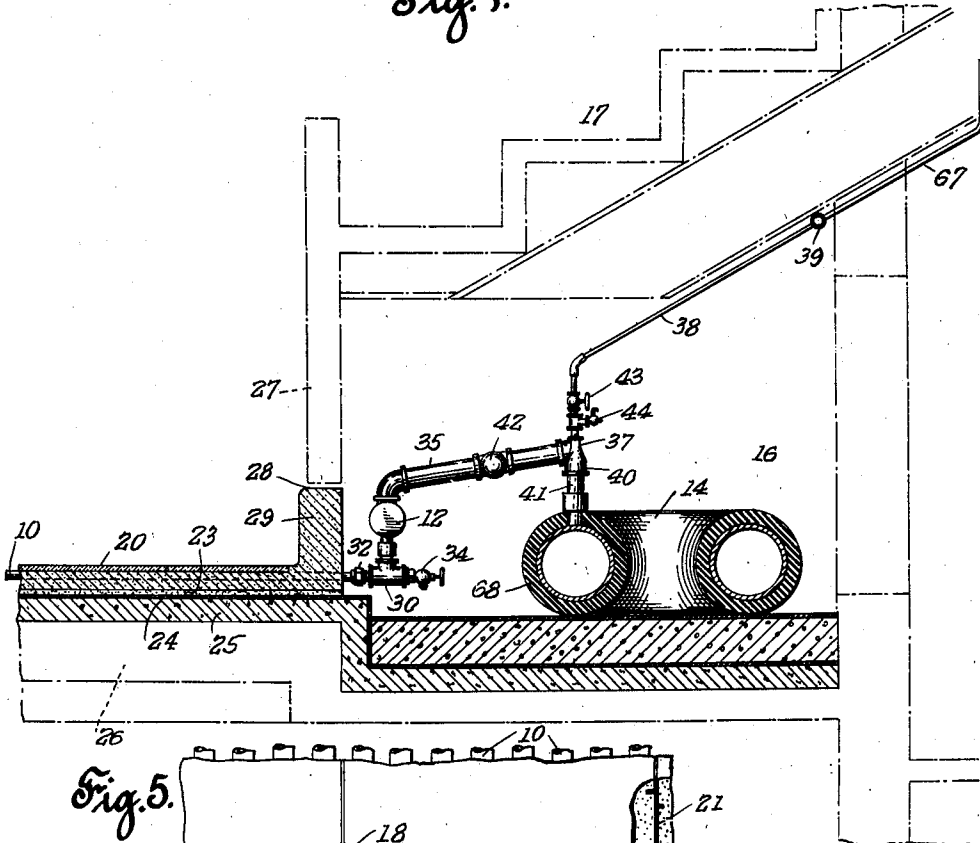


Fig. 5.

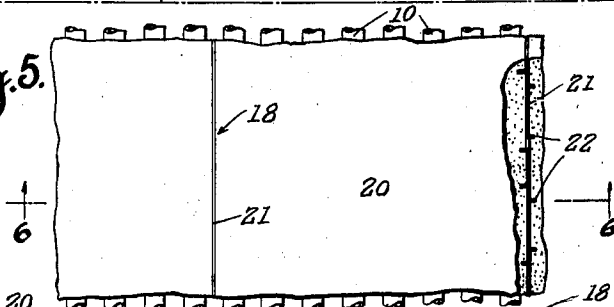
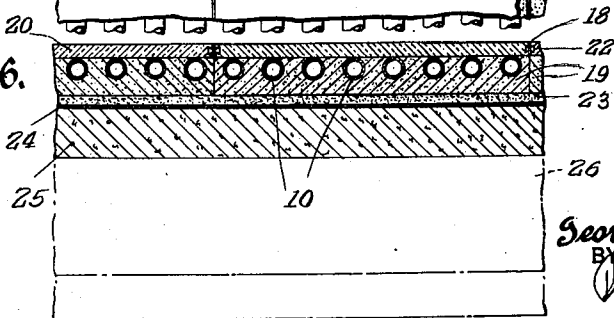


Fig. 6.



INVENTOR

George C. Funk  
BY Philip S. McLean.  
ATTORNEY

**July 5, 1927.**

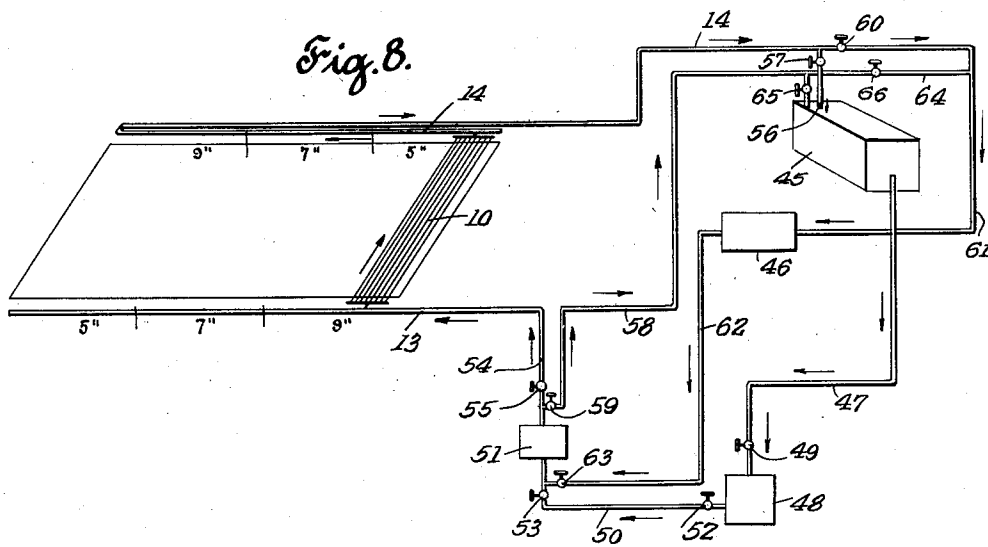
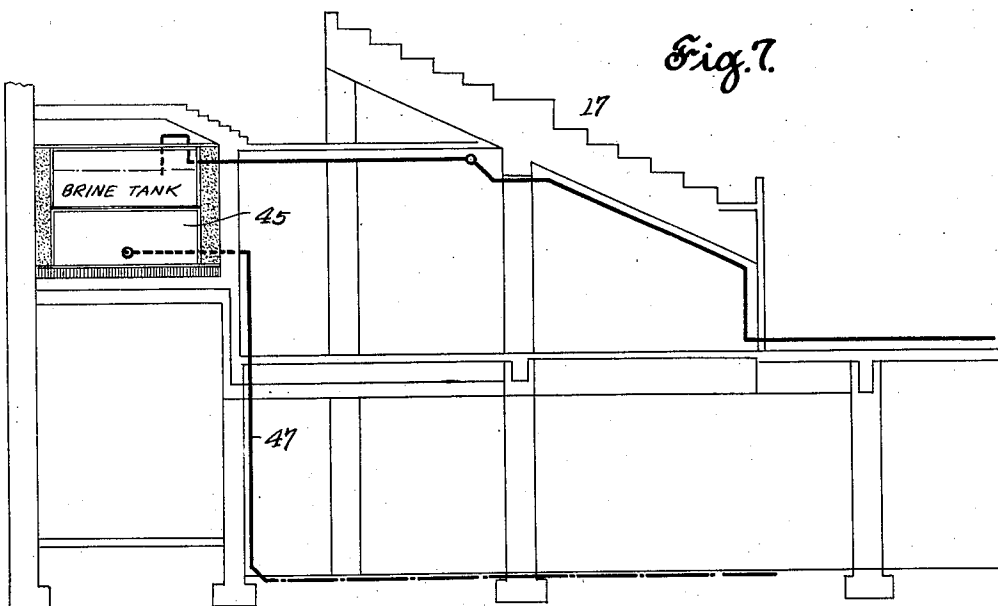
**1,634,938**

**G. C. FUNK**

ICE SKATING RINK

Filed Oct. 16, 1926

4 Sheets-Sheet 4



INVENTOR  
*George C. Funk*  
BY  
*Philip S. McLean*  
ATTORNEY

## UNITED STATES PATENT OFFICE.

GEORGE C. FUNK, OF BROOKLINE, MASSACHUSETTS.

## ICE-SKATING RINK.

Application filed October 16, 1926. Serial No. 141,946.

The general objects of the present invention are to provide a floor structure adapted to be used interchangeably for ordinary floor purposes or for an ice skating rink and which can be converted from the one use to the other in relatively short time, without harm from sudden contraction or expansion, to the floor or to the building of which it may form a part.

Special objects of the invention are to enable the preparations for freezing or melting, as the case may be, to be proceeded with without interfering or detracting in any way from the full and proper use of the floor at any given time.

Other and further important objects are to provide a complete system as outlined, which will be relatively simple and inexpensive for the results attained, which will be entirely practical and which will be readily capable of installation either in existing buildings or in new structures especially designed for the purpose.

Further objects and the many novel features of construction, combinations and relations of parts which relate to and are comprised within the invention will appear in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate a practical embodiment and various modifications of the invention, but as will appear from the broad scope of the claims appended, the actual structure may be further modified and changed without departure from the real spirit and true scope of the invention.

Figure 1 is a diagrammatic plan view illustrating an adaptation of the invention to an arena designed particularly for use at different times for hockey matches and for boxing bouts, carnivals, dances, circuses and the like.

Figure 2 is a vertical sectional view as on substantially the plane of line 2—2 of Figure 1 showing particularly the supply main and connections therefrom to the floor pipes.

Figure 3 is a broken plan view of the piping appearing in Figure 2.

Figure 4 is a cross sectional view taken through the return main trench as on substantially the plane of line 4—4 of Figure 1.

Figures 5 and 6 are partial plan and cross sectional views respectively of the floor structure, the latter view showing in particular the pipes embedded in the floor slabs and the manner in which the latter are

movably supported on a sand layer and thermally insulated by a layer of cork, which latter is protected by a waterproofing layer.

Figure 7 is a sectional view as on the line 7—7 of Figure 1 illustrating particularly the brine tank and related connections.

Figure 8 is a diagrammatical view illustrating the brine circulation.

The use of the floor for both ordinary purposes and for ice skating is accomplished in the present invention by building the floor with a finished wearing surface and by embedding the refrigerating or circulating pipes in the body of the floor. These circulating brine pipes are designated 10 and are shown as extending crosswise of the arena in gangs of eight (Figures 3 and 6) connected at opposite ends with supply and return headers 11, 12 respectively. These headers and the supply and return mains 13, 14 with which they are connected are shown located in trenches 15, 16 extending along the opposite sides of the arena beneath the overhanging seating structure 17.

The floor pipes constitute transverse reinforcements effectively taking care of the transverse contractive and expansive force and to allow for the longitudinal contraction and expansion the floor is divided into slabs on lines 18, parallel to the pipes and at opposite sides of each gang of the pipes. These lines of severance constitute expansion joints and when desired may be packed with suitable elastic material or otherwise constructed to afford a sealed joint at all times. In some cases, it is sufficient to merely have the slabs in abutting engagement and this is the structure illustrated in Figure 6 of the present disclosure.

In this view 19 indicates the cementitious body of the slab in which the pipes are embedded and 20 the superimposed floor surface of terrazzo or the like, the lines of severance extending down through both the wearing surface and the body and the terrazzo edges being protected by inserted strips 21 of brass or the like anchored in the material of adjoining slabs by outwardly struck integral wings or lugs 22. These strips act as a flexible bond between adjacent slabs and to a certain extent serve in themselves as expansion joints.

Under the extreme temperature changes to which the floor is necessarily subjected, the contractive and expansive efforts are

considerable. To prevent destructive application of such forces to the surrounding building walls or the like, the slab floor is in effect "floated" on a supporting structure and in a free or non-rigidly connected relation. In the present disclosure, the floating support is a bed 23 of dry sand, protected from below by a waterproofing layer 24 which is shown applied directly over the bed 25 of thermal insulating material. This insulating material may be cork or the like and this is shown as mounted on the permanent structural floor 26.

Figures 2 and 4 show how the seating structure forms a cover over the trenches but is left disconnected from the floor by cantilever construction even where the arena wall 27 comes down to meet the floor, an open joint 28, expansion joint or the like being left where the foot of this wall opposes the upstanding curb 29 at the edge of the skating floor.

The floor pipes are shown connected with the headers by T-fittings 30 arranged with their through passages in line with the pipes and with their branches 31 directed upwardly and connected into the bottoms of the headers. Unions 32 are shown detachably connecting these fittings to the pipe ends. The inlet fittings are shown closed at their outer ends by removable plugs 33 and the outer ends of the outlet fittings are shown closed by drain or draw off valves 34. This construction enables individual pipes being readily disconnected and cut out of service, inspected, repaired, cleaned or the like. Complete disconnection of different pipes may be effected at the unions 32 and the plugs 33 and valves 34 at the opposite ends of the pipes provide through passageway for washing out or cleaning the pipes. This construction also permits the application of pressure to any pipes that may be clogged or partially stopped up, the usual practice being to apply pressure to the entire gang of pipes, leaving open only the valve at the end of the clogged pipe so that the accumulated pressure will be effective to remove any obstruction therein. This construction also is advantageous in the location of the headers above the pipe level, making the headers and the connections thereto more accessible and requiring the use of only a comparatively shallow trench for these parts.

The headers being carried by the pipes partake of the slab movements and so the connections with the mains include the equivalent of expansion joints. In the illustration, the connections from the headers to the mains consist of piping 35 from the tops of the headers having bends 36 entered in the tops of the mains and which, as indicated in Figure 3, are of sufficient extent to constitute "swing joints" allowing for both

lateral and longitudinal displacement of the slabs with respect to the mains without disruption of any connections.

This piping, as indicated in Figures 2 and 4, is preferably inclined from the mains toward the headers for drainage purposes and to provide air space at the main ends, at the high points 37 from which air vent connections 38 extend to air vent mains 39. The connections at 37 are indicated as provided in the tops of the elbows 40 which form part of the down connections 41 into the brine mains. The shut-off valves 42 are shown provided in these swing connections for enabling any one or more of the headers being cut out of circuit. Valves 43 enable any of the air vent connections 38 being cut out of service and pet cocks 44 enable the testing of any of these air exhaust branches.

Brine or any other suitable liquid or medium may be employed as the heat exchange medium but for descriptive purposes brine will be considered as the medium. One of the important novel features of the brine circulating system is the provision of a brine tank, designated 45, which has at least double the capacity of the floor pipes and the provision of means by which the brine tank may be cut off from the floor system and the brine therein be cooled in readiness to go into the floor as soon as the floor becomes available.

Another special new feature is the provision of a heater for the brine, designated 46, which can be cut off from the brine tank and be utilized to heat only that portion of the brine which is in the floor system.

These features will be best understood by reference to Figure 8 which discloses one preferred method of associating such parts. In this view, an outlet 47 in the bottom of the brine tank is connected with an ice machine or cooler 48 and controlled by a valve 49. The ice machine or cooler is connected by pipe 50 with the inlet or suction side of the circulating pump 51, with a valve 52 located at the ice machine or cooler end of this pipe and a valve 53 at the pump end of the same. The outlet or discharge side of the pump is connected by piping 54 with the supply main 13 under control of valve 55. The return main 14 is connected by piping 56 with the top of the brine tank, controlled by valve 57. The normal circulation for refrigeration purposes is by way of the connections described, all the valves referred to in such case being open.

When the arena is being used for boxing bouts or other purposes and is to be used for ice skating purposes immediately following such events, the floor system is cut out of circulation and a pre-cooling circulation is set up from the brine tank through the ice machine and pump and by way of a connection

tion 58 back into the top of the brine tank. This connection, it will be seen, in effect by-passes the floor system when the main floor valve 55 is closed and by-pass valve 59 is opened. This pre-cooling circulation may be maintained for a considerable period prior to the emptying of the arena and as the capacity of the brine tank is greater, usually about twice that of the floor system, it will be seen that there can be thus provided, a large body of cold brine, all ready to be supplied to the floor the moment the floor is cleared. This larger body of colder brine mingling with the smaller body of warmer brine in the floor quickly lowers the temperature of the lesser body and rapidly brings the floor surface down to proper ice forming temperature.

The water for freezing is not applied to the floor until the latter is sufficiently chilled to effect an immediate freezing and preferably the water is supplied in the form of a spray so as to freeze first as a hard thin film and so as to prevent water entering the expansion joints and forming ice between the slabs of the floor. After this first thin layer, other layers may be sprayed on or the water flowed on, as desired. By regulating the circulation and the action of the ice machine, the ice may be tempered and kept in the best condition for skating or other purposes.

When the floor is to be cleared of ice, the brine tank is cut out of circulation and the brine in the floor is circulated through the heater. Under these circumstances, the brine tank return valve 57 is closed and a valve 60 in the piping 61 extending from the return main to the heater is opened. The heater is connected by piping 62 with the inlet side of the pump under control of valve 63 so that with the ice machine valve 53 closed and the main flow valve 55 opened, the pump will create a flow of heated brine through the floor pipes. This flow quickly breaks the bond between the ice and the floor, enabling the ice to be broken up or removed in any suitable fashion.

If desired, a portion of the brine may be pre-heated while the ice on the floor is still in use by by-passing the same from the floor through the heater. The circulation under these circumstances would be, with the floor valve 55 closed, from the pump through open by-pass valve 59, the by-pass 58 and a branch 64 from the by-pass to the heater return 61. During such circulation the by-pass return to the tank would be cut off by valve 65 and the valve 66 in branch 64 would be opened and valve 60 at the entrance to the heater return be closed so that the brine would flow in a closed circuit through the heater, independently of the brine tank, cooler and floor system. A quantity of heated brine is thus

made ready and available the instant the skating is finished, upon opening the main floor valve 55 and the heater return valve 60. The hot brine mingling with the brine in the floor helps to bring the latter quickly up to melting temperature and to that extent facilitates the action of the heater in the ice melting operation. While circulating the floor brine through the heater, the by-pass 58 may be cut off at the valves 59 and 66.

The air elimination system by its connections with the highest points in the liquid circulation system prevents air pocketing and permits proper flow of the heat exchange medium at all times. The air vent mains 39 are indicated in Figure 1 as discharging into the top of the brine tank and risers 67 are indicated extending from the air relief mains to the roof or some other elevated position.

As there is no bond between the skating rink floor and the supporting structure and as the floor is sectionalized in one direction and completely reinforced in the other way, no injury results to either the floor or the building from the sudden effects of contracting and expanding following the changes from heating to cooling and vice versa. The changes from one set of conditions to the reverse set are quickly effected and the by-passing of the floor while subjecting a quantity of the brine to one condition or the other, greatly speeds up the action and prevents any appreciable loss of time in the use of the floor. The piping is simple and direct and such that any faults may be localized and corrected. The floor pipes or any selected number or group of them may be flushed out or otherwise treated as required. By spraying the water on the cold floor it is made to freeze instantly and there is therefore no detrimental saturation of the concrete or penetration of the joints between the slabs. This spraying feature also makes it possible to freeze the ice in any desired shape on the floor, either in the form of a track, a series of strips or a single localized area, for instance. The ice frozen in this form also is stronger so that a relatively thin skin of the same serves as well or better than a thick layer, enabling economical use of water and freezing medium and also leaving a lesser quantity of ice to be removed.

A substantially equal distribution of flow through the floor pipes is assured in the structure disclosed by doubling the return main as indicated particularly in Figure 1, the entire length of that side of the floor and connecting the floor pipes into the terminal side 68 of this loop so that those pipes which are nearest to the brine source will be connected in the furthest end of the return main and those further from the sup-

ply will be progressively connected with nearer portions of the return main. This equalizing of the flow produces a substantially even freezing or thawing as the case may be over the entire floor area. The mains and other exposed portions of the piping may be suitably insulated as for instance indicated in Figures 2 and 4.

In the pre-cooling process, the larger body of brine in the brine tank is reduced to a temperature much below that required for freezing, say to about 9 degrees F. above zero, so that, with its greater volume, it can take up heat from the floor body and from the floor itself and still maintain the temperature of the mixed body below freezing. Thus, practically no time is lost before the actual formation of the ice surface can be started.

The preparatory cooling, that is, the cooling of the main or large body of brine, is effected while the floor is occupied and at a distant point, so the users of the floor are not affected by such operations and the change from one condition to the other may be started immediately as soon or actually even before the floor is cleared. By thoroughly chilling the floor before applying the water and then applying the water only in the form of a light spray which immediately freezes and forms a coating on the floor slabs, practically no water penetrates the joints between the slabs and no water is taken up by the concrete. This means that the floor need not be made watertight and also that there is no disintegration of the concrete such as would follow on alternate freezing and melting of a water soaked concrete.

The invention is applicable to many uses and in many different combinations, for instance, in hotels, theatres, auditoriums, on the roofs of buildings and the like, no special form or type of building structure being required.

If any of the floor pipes become air bound, this condition can be quickly cured by opening the valve 34 at the end of the same and these valves provide a means for testing air bound conditions whenever any uneven freezing over the floor is observed. Uniformity of freezing over the entire floor area is further assured by graduating the size of the supply and return mains in reverse order. Thus, as indicated in Figures 1 and 8, the first one-third section of the supply main 13 may be of nine inch diameter, as designated in the views referred to, the second third of seven inch diameter and the last third of five inch diameter; and the inner side in the loop of the return main opposite the five inch section be of nine inch diameter, the middle section of seven inch diameter and the end section, opposite the larger portion of the supply main of five

inch diameter. This reverse graduation of the two mains effects a substantially uniform flow through both the end and central portions of the floor pipe, thus maintaining a substantially uniform cooling or heating effect, as the case may be. The uniformity in the ice surface thus created and maintained is practically necessary for the playing of ice games such as hockey and the like.

If desired, the headers may be omitted and the floor pipes be connected directly with the mains and various other changes may be made, all within the scope of the invention.

What is claimed is:

1. A skating floor comprising in combination with a supporting structure, a layer of thermal insulating material on said supporting structure, a waterproof layer on said insulating layer, a layer of dry sand on said water-proofing layer, a wearing floor having a floating support on said sand layer, pipes for the circulation of heat transferring medium embedded in said floating floor structure and means for circulating a heat transferring medium through said pipes, including connections yieldable to permit of the floating action of the floor.

2. A skating floor comprising in combination with a supporting structure and a wearing floor divided into slabs, thermal insulation, a waterproofing layer and a bond preventing layer interposed between the structural support and floor slabs, circulating pipes embedded in the floor slabs, means for circulating heat transferring medium through said pipes and means for venting the air from the highest points of said circulating connections.

3. In a skating rink, a supporting floor structure, a wearing floor consisting of a body and a superimposed floor surface both sectionalized into slabs, thermal insulation, waterproofing and a non-bonding support for the floor slabs interposed between the supporting structure and floor slabs, circulating pipes embedded in the body portions of the floor slabs below the finishing top surface and means for circulating a heat transferring medium through said pipes.

4. In a skating rink, a supporting floor structure, a wearing floor consisting of a body and a superimposed floor surface both sectionalized into slabs, thermal insulating, waterproofing and a non-bonding support for the floor slabs interposed between the supporting structure and floor slabs, circulating pipes embedded in the body portions of the floor slabs below the finishing top surface, means for circulating a heat transferring medium through said pipes and joint strips interposed between the top layers of the floor slabs and flexibly bonded thereto.

5. In a skating rink, a supporting structure, a sectionalized wearing floor mounted in unconfined free floating relation on said supporting structure, thermal insulation, waterproofing and non-bonding layers between the floor sections and supporting structure, circulating pipes embedded in the floor sections, supply and return mains adjacent the ends of the floor sections and readily detachable flexible piping between the mains and pipes.

6. In a skating rink, a supporting structure, a sectionalized wearing floor mounted in unconfined free floating relation on said supporting structure, thermal insulation, waterproofing and non-bonding layers between the floor sections and supporting structure, circulating pipes embedded in the floor sections, supply and return mains adjacent the ends of the floor sections and piping connections inclined downwardly from said mains to said floor pipes.

7. In a skating rink, a supporting structure, a sectionalized wearing floor mounted in unconfined free floating relation on said supporting structure, thermal insulation, waterproofing and non-bonding layers between the floor sections and supporting structure, circulating pipes embedded in the floor sections, supply and return mains adjacent the ends of the floor sections, piping connections inclined downwardly from said mains to said floor pipes and air vents extending upwardly from the upper portions of said inclined piping.

8. In a skating floor, a supporting structure, a sectionalized wearing floor mounted in free floating relation on the supporting structure, circulating pipes embedded in the sections of said floor and exposed at the ends of said sections, a supply main extending down one side of the floor and connected with the ends of the pipes exposed thereat, a return main having a loop extending double length at the opposite side of the floor and having the terminal side of the loop connected with the pipe ends exposed at said side of the floor and circulating means connected with said mains.

9. In combination, a skating floor, a floor circulation system, means for cooling the circulation medium, a circulating pump, a tank for holding a supply of the medium in excess of that contained in the floor and means for closing off the floor system and circulating the tank supply through the cooler and for subsequently circulating said greater volume of pre-cooled medium from the tank through the floor system, a heater and means operable in conjunction with the other circulating means to bypass the floor system and independently circulate a portion of the medium through said heater or from the heater through the floor system.

10. In a skating rink, a floor circulation

system, a supply tank, an ice machine, a heater, a circulating pump and connections for causing said pump to circulate the contents of the tank through the ice machine independently of or in conjunction with the floor system or to cause the pump to create a flow through the heater independently of or in conjunction with the floor system.

11. In a skating rink, a wearing floor, refrigerant circulating pipes embedded therein, a pump, a heater and means for causing said pump to circulate a heat transferring medium through the heater independently of the circulating pipes in the floor or through the heater in conjunction with said circulating pipes in the floor.

12. The process of freezing ice on a skating rink floor in which the circulating pipes are embedded in the wearing floor structure which comprises pre-cooling a larger body of the cooling medium than that contained in the floor pipes while the floor is in use for other than skating purposes and then, when the floor is available, circulating said pre-cooled medium through the floor system.

13. The method of operating a floor for skating and other purposes, in which heat transferring pipes are embedded in the floor which comprises pre-cooling a larger body of the circulating medium than that in the floor, apart from the body in the floor and then, as soon as the floor is available, coupling said larger pre-cooled body to the lesser floor content body and subjecting the joint bodies to circulation and cooling influences.

14. The method of operating a floor for ice skating and other purposes in which the circulating pipes are embedded in the floor which comprises pre-cooling a body of heat exchange medium to a temperature much lower than that required for freezing, apart from the body in the floor system while the floor is still in use for other than ice skating purposes, flowing said pre-cooled body into the floor system as soon as the floor is available and by mingling same with the body in the floor system quickly bringing that body down to the necessary temperature for freezing water on the floor.

15. The method of operating a floor for ice skating and other purposes in which the circulating pipes are embedded in the floor which comprises pre-cooling a body of heat exchange medium to a temperature much lower than that required for freezing, apart from the body in the floor system while the floor is still in use for other than ice skating purposes, flowing said pre-cooled body into the floor system as soon as the floor is available and by mingling same with the body in the floor system quickly bringing that body down to the necessary temperature for freezing water on the floor and then when the floor is to be converted to other than ice skating purposes, cutting off said

external body from the floor body and coupling a heater in circuit with said floor body to thereby apply heat directly to the medium in the floor.

5 16. A floor for ice skating purposes having refrigerant circulating pipes embedded therein, a supply main of graduated size connected with said pipes and a return  
10 main having a loop portion of reversely graduated size connected with the opposite ends of the pipes.

17. The method of creating an ice skating surface on a floor containing embedded  
15 refrigerant circulating pipes and having joints which render the surface of the floor non-watertight, said method comprising circulating a chilled refrigerant through the  
20 embedded pipes while the floor is clear of surface water and until the surface of the floor is reduced to a temperature below that  
25 of the overlying air and to a point where water sprayed thereon will instantly freeze, spraying water on said chilled floor surface so as to cover the joints with an instantly-  
forming, thin hard film of water-excluding ice and then while continuing the refrigerant  
30 circulation to maintain said initial coating film, flowing on additional water to freeze over said surface layer of ice.

18. A skating floor comprising in combination with a supporting structure, layers  
35 on said supporting structure of thermal insulating material, waterproofing material and bond preventing material and a wearing floor on top of said layers of material  
40 and thereby supported in floating thermally insulated relation on the supporting structure and with provision for preventing water from the floor reaching the supporting structure,  
45 refrigerant circulating pipes embedded in said floating floor structure and means for circulating a heat transferring medium through said embedded pipes.

19. In a skating rink, a floor circulation  
50 system, an ice machine, a refrigerant storage tank independent of the ice machine, circulating pump means and valved connections for effecting flow of the refrigerant in a closed circuit, including the pump means,  
ice machine and storage tank independently  
55 of and outside the floor circulation system to precool a body of the refrigerant apart from and prior to use in the floor, and for subsequently flowing the precooled sep-

arately stored body of refrigerant from the  
storage tank, through the ice machine, pump  
means and floor circulation system.

20. In a skating rink, a floor circulation  
60 system, an ice machine, a refrigerant storage tank independent of the ice machine, circulating pump means and valved connections for effecting flow of the refrigerant in a closed circuit, including the pump  
means, ice machine and storage tank independently of and outside the floor circulation  
65 system to precool a body of the refrigerant apart from and prior to use in the floor, and for subsequently flowing the precooled separately stored body of refrigerant from the storage tank, through the ice machine,  
70 pump means and floor circulation system, a heater for the refrigerant and valved connections linking said heater with the other circulating connections and enabling  
75 the pump means to circulate refrigerant in a closed circuit with the heater or in the floor circulating system through the heater, and both said latter circuits independently of  
the ice machine and precooling storage tank.

21. The method of operating a floor for  
80 ice skating and other purposes in which the refrigerant circulating pipes are embedded in the floor and which comprises precooling a body of refrigerant to a temperature much lower than that required for freezing apart  
85 from and separated from the floor circulating system while the floor is in use for other than ice skating purposes, flowing this separately precooled body of refrigerant into the floor circulating system when the floor  
90 is available, spraying water on the chilled floor surface to build up an ice layer thereon and then when the floor is to be returned to its former uses, warming that part of  
95 the refrigerant which is in the floor circulating system to break the bond between the floor surface and superimposed ice layer and removing the ice thus freed from the floor.

22. A floor for ice skating purposes having  
100 refrigerant circulating pipes embedded therein, supply and return mains of reversely graduated size connected with opposite ends of the floor pipes and circulating means connected with said mains.

In witness whereof, I have hereunto set  
105 my hand this 21st day of September, 1926.

GEORGE C. FUNK.