July 11, 1933. M. R. CARPENTER 1,917,634

ICE RINK STRUCTURE

Filed Sept. 8, 1930 3 Sheets-Sheet 1

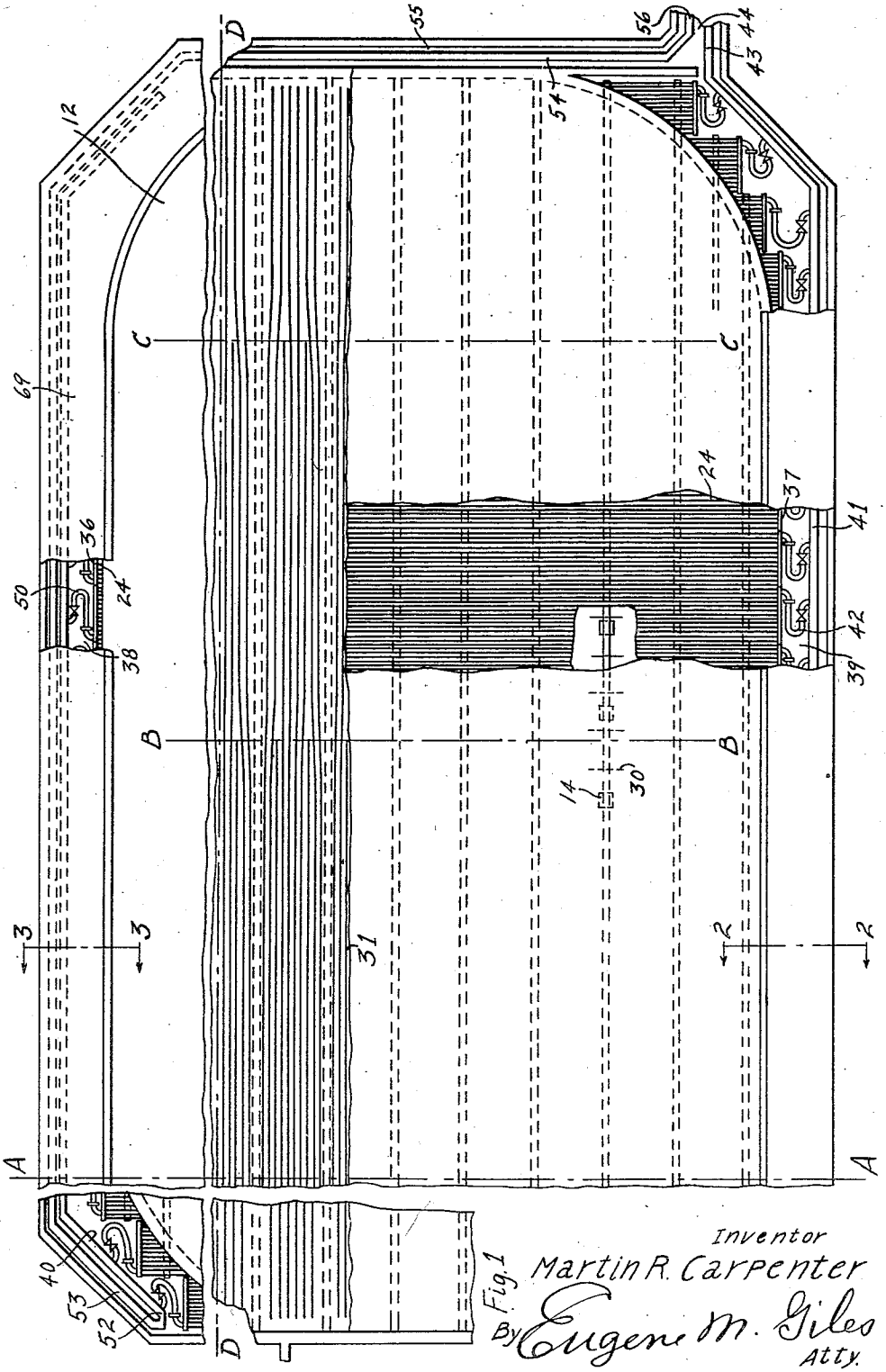


Fig. 1

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ICE RINK STRUCTURE

Filed Sept. 8, 1930 3 Sheets-Sheet 2

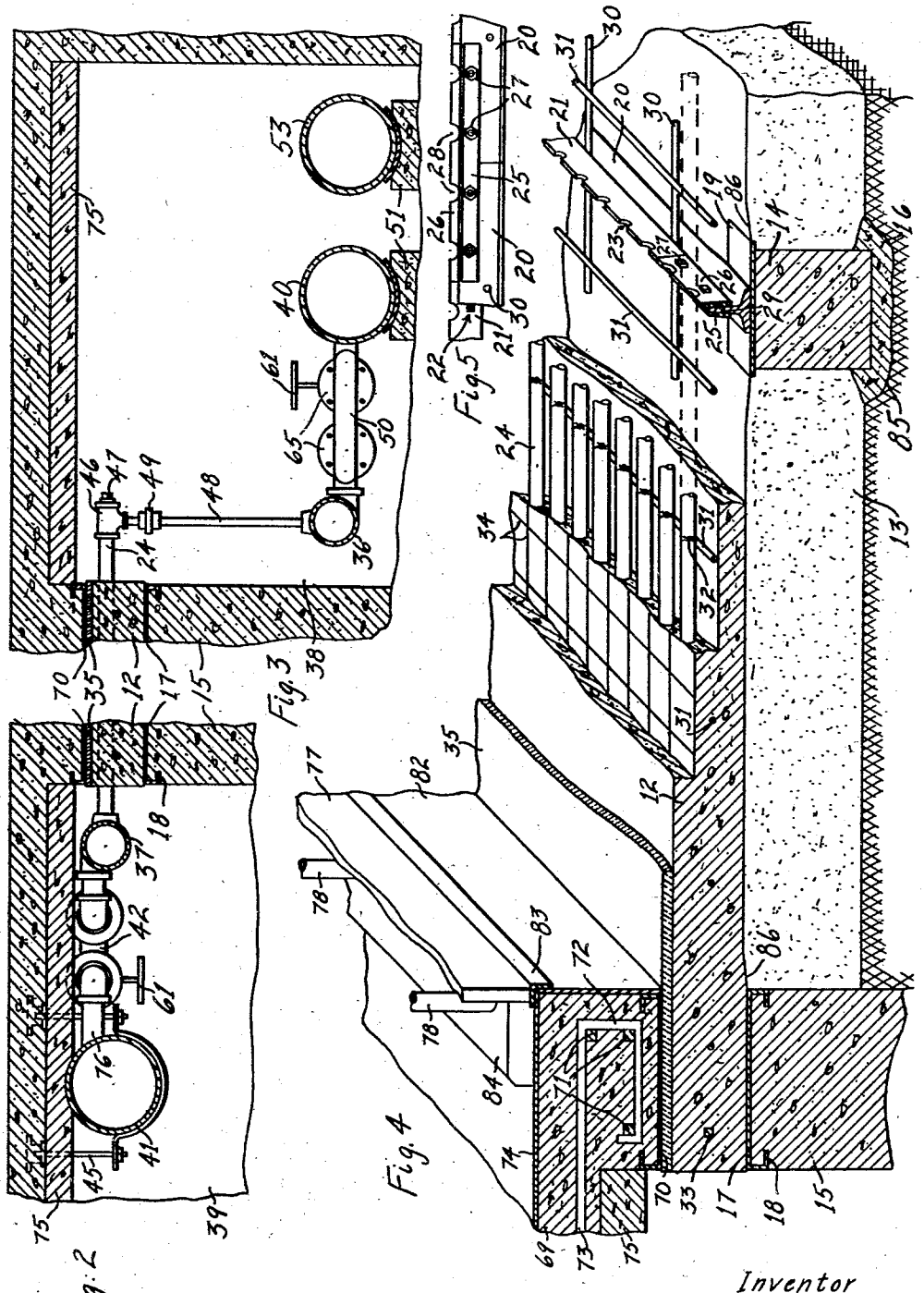


Fig. 2

Fig. 3

Fig. 4

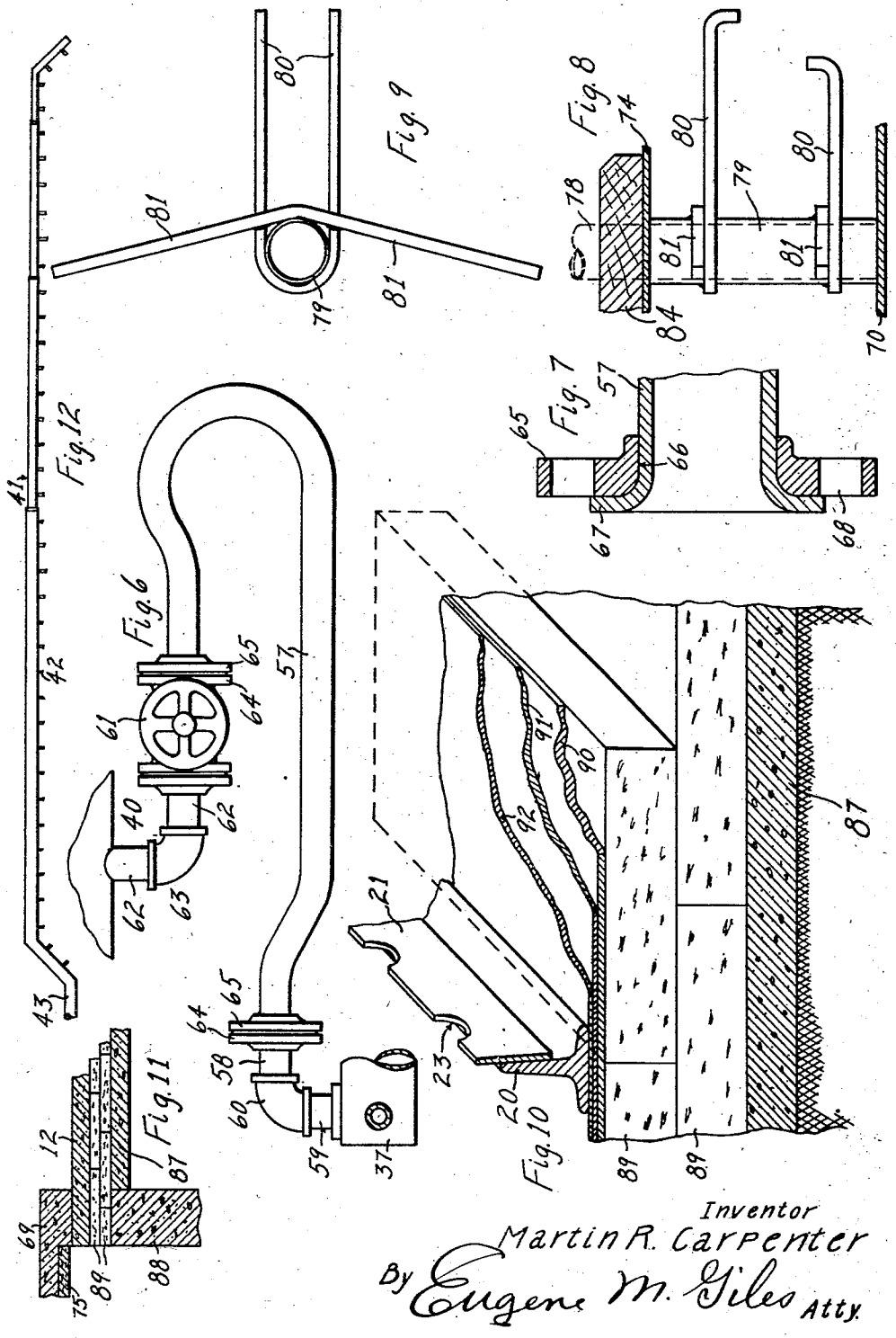
Fig. 5

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ICE RINK STRUCTURE

Filed Sept. 8, 1930 3 Sheets-Sheet 3



Patented July 11, 1933 1,917,634

UNITED STATES PATENT OFFICE

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ICE RINK STRUCTURE

Application filed September 8, 1930. Serial No. 480,323.

My invention relates to rinks wherein ice is artificially formed on a floor, and has reference more particularly to the construction and mounting of floors of this character so as to expand and contract freely and without any detrimental effects under the changes of temperature which necessarily occur.

In ice rinks a floor of concrete or other composition and of relatively large area is usually provided, having a curb around the edge and pipes embedded in the floor through which a cooling medium is circulated from refrigerating apparatus for freezing water on the floor to form a layer of ice thereon, and such floors, on account of their large area and the variations of temperature to which they are subjected, expand and contract to such an extent that when constructed in accordance with the best practice heretofore known, they soon break, buckle and disintegrate and cause excessive trouble and expense.

This breaking down of the floor, while resulting principally from repeated expansion and contraction, is due primarily to cracks or fissures which have been provided in the floor, when built, in the form of seams or expansion joints or which may subsequently develop on account of inadequate or improper precautions for preventing same, as for example; insufficient freedom of movement or floating action of the floor to permit the necessary expansion and contraction without binding or cramping strains which in the expansion cause buckling and in the contraction cause pulling apart of portions of the floor; lack of suitable and properly arranged reinforcing to withstand the strains of expansion and contraction, and particularly insufficient tying together of all parts of the floor to insure drawing inward or return movement thereof in contraction; improper mounting and impairment or breaking down of the floor supporting structure which permits the floor to yield and crack; improper floor composition or non-uniformity or variations in the character of the mixture used at different places throughout the floor and particularly the employment of strata of dissimilar materials having different expansion characteristics; and unequal changes of temperature at proximate places throughout the floor due to "short cut" circulation through certain pipes which are nearest to the inlets and outlets. Such cracks or fissures whether pre-arranged in the form of seams or expansion joints or subsequently developed on account of improper mounting, lack of proper reinforcing or suitable provision for expansion and contraction, inequalities of temperature distribution, non-uniformity of floor composition, or otherwise, afford avenues through which water and moisture, which is necessarily present at times on the rink floor, will penetrate into and under the floor and eventually ruin it for its intended purpose, as the water and moisture entering the cracks or seams and expansion joints, in the subsequent freezing operations not only progressively increases the separation of the cracked sections of the floor but introduces new and additional cracking and bulging strains, while the water and moisture which works its way down through the cracks and seams and under the floor, unless promptly drained away, causes bulging, swelling, rotting out of any wood that may have been used and other impairment of the floor supporting structure with a resultant disintegration of the floor.

Therefore, it is important not only to avoid seams or joints but also to construct and mount the floor with ample safeguards against all of the various stresses, strains and other conditions peculiar to these floors, which are likely to develop cracks, this being of special importance in ice rink floors which are used for other purposes in addition to skating, as for example for dancing, exhibitions, etc., as it is oftentimes necessary to remove and replace the ice quickly and at frequent intervals. In such cases it is customary when the ice is to be removed to loosen up the ice by warming the liquid which is circulated through the floor piping, and the floor is accordingly subjected to frequent and abrupt changes of temperature with correspondingly frequent and severe expansion and contraction strains.

With my invention the difficulties encoun-

tered with previous floors are entirely avoided by taking care of the expansion and contraction without the necessity of seams or expansion joints, the floor being of a permanent monolithic form having uniform expansion characteristics throughout the entire mass and suitably supported and properly reinforced to obviate any stresses and strains that might result in cracks.

The principal objects of my invention are to provide an improved ice rink floor structure and method of making same; to construct the floor in a permanent monolithic form without seams or expansion joints; to avoid cracking of the floor and prevent penetration of water and moisture into and through the floor; to mount the floor in a floating manner so that it expands and contracts freely without binding; to incorporate reinforcing in the floor in a manner to insure rigidity and withstand the strains of expansion and contraction and maintain the entire floor in a permanent, unbroken, unitary form; to insure a permanent unyielding support for the floor and at the same time afford adequate slippage for expansion and contraction; to permit convenient and effective insulation of the floor on the underside; to provide improved connections for the headers; to arrange the connections so that they are below the desired level of the surrounding floor; to mount the floor pipes in an improved manner; to utilize the pipe mounting for reinforcing the floor; to provide an improved mounting for the railing around the floor, and in general to provide a floor structure and method of making same wherein the supporting, reinforcing, composition and unification of the floor, the provisions for expansion and contraction, and the manner of effecting changes of temperature are all co-related in a proper manner to insure ample strength and durability and to effectively avoid the difficulties heretofore experienced with floors of the character to which this invention relates.

On the drawings:—

Fig. 1 is a plan view of substantially one-quarter portion and remote edge portions of a floor structure embodying my improvements, with parts thereof broken away at places to disclose details of the construction;

Fig. 2 is an enlarged section taken substantially on the line 2—2 of Fig. 1 showing a portion of the trench and the connections at one side of the floor;

Fig. 3 is a similar section taken substantially on the line 3—3 of Fig. 1 showing a portion of the trench and connections at the other side of the floor;

Fig. 4 is an enlarged fragmentary sectional and perspective view of an edge portion of the floor;

Fig. 5 is a side view of connected end portions of the pipe supporting members;

Fig. 6 is a plan view of the expansion connection which is employed between the headers and the mains;

Fig. 7 is a sectional view of the coupling at the end of the expansion connection;

Fig. 8 is a side view and Fig. 9 a top view of the post socket for the railing around the rink floor;

Fig. 10 is a fragmentary sectional and perspective view of a modified structure wherein an insulating base is provided for the rink floor;

Fig. 11 is a detail sectional view of the edge portion of the insulated base floor structure of Fig. 10, and

Fig. 12 is a plan view of one of the mains showing the reduction in size thereof.

In ice rinks of the type to which my invention relates there are two forms of construction which may be employed, one of which is adapted for use where the rink floor is built on the ground and used principally or entirely for skating purposes, in which case it is unnecessary to remove and replace the ice at frequent intervals, and the other of which is designed particularly for use where the rink is located over a basement or on an upper floor or is used for other purposes in addition to skating, in which cases special precautions are necessary or desirable to insulate the floor on the underside so as to prevent the basement or rooms under the rink being affected by the rink temperature and facilitate the removal and replacement of the ice by avoiding downward dissipation of temperature changes and minimizing the mass of material which it is necessary to cool each time the ice is to be replaced.

In the first mentioned form of construction, in connection with which my invention is illustrated in Figs. 1 and 4, the rink floor proper, which is indicated as a whole at 12 is placed directly upon a layer 13 of sand with a plurality of supports 14 arranged at intervals throughout the area of the floor, and a retaining wall indicated at 15 extending entirely around and preferably under the edge of the floor. The supports 14 may be concrete blocks of proper height according to the depth of the layer 13 of sand and each is preferably set in a base 16 of concrete, said blocks being arranged in spaced relation lengthwise of the floor in laterally spaced parallel lines or rows, the blocks of each row being spaced apart longitudinally of the rink floor for example about nine feet and said rows being spaced apart transversely of the floor substantially the same distance.

The wall 15 which extends around and under the marginal edge portion of the floor is built up to substantially the level of the top of the blocks 14 and the top surface of said wall is faced with a metal cap 17, preferably of sheet zinc, which has the edges turned downwardly and bent inwardly as

indicated at 18 to bite into the concrete wall 15 while the latter is soft so that the cap plate 17, in addition to its being held in place by the natural affinity of the zinc and concrete is further secured against displacement by the downturned edges. The blocks 14 are also metal covered, plates 19 which may also be of zinc, being provided for this purpose. These plates 19, however, are not secured to their respective blocks but the latter are preferably preformed and the plates 19, which are larger than and project outwardly around the blocks substantially as shown in Fig. 4, are placed loosely on the blocks 14 and become bonded to the underside of the floor 12 when the latter is poured in place. For example, the top faces of the blocks 14 may be about eight inches square in which case the plates 19 would be approximately 12 inches square so as to extend about two inches beyond the top face of the block all the way around.

These rink floors have a plurality of pipes embedded therein for circulating the cooling medium through the floor and for the purpose of locating and holding these pipes at the proper elevation and in the proper spaced relation while the floor is being assembled and poured, I mount a longitudinal girder on each longitudinal row or series of supports 14 so as to serve as longitudinal reinforcing means for the floor and I construct these girders so as to space and support the pipes which are built into the floor. These girders may be of any desired construction but preferably consist of lengths 20 of T-iron which have plates 21 secured to and extending above the upright web of the T-iron, said plates 21 being preferably spot welded at intervals throughout their length to the T-irons 20 as indicated at 22, and said plates are provided in their upper edges with semi-circular recesses 23 to form seats for the floor pipes 24. The contiguous ends of the adjoining lengths or sections 20 of the girders are located over blocks 14 to insure adequate support for such ends and these ends are joined together by clamping or connecting plates 25 and 26 which are arranged on opposite sides respectively of upright web portions of the adjoining ends of the T-iron sections 20 and secured together with said web portions therebetween by bolts 27. The connecting plate 26 which extends above the T-iron 20 so as to form a continuation of the contiguous plates 21 has recesses 28 in the upper edge corresponding to and spaced apart like the recesses or seats 23 of the plates 21 for supporting pipes 24 and said connecting plates 26 may be additionally secured to the ends of the T-iron sections 20 by spot welding as indicated at 29, it being understood that these stringers or girders and their plates 21 and 26 do not extend above the pipes 24 and that they are accordingly well below the top of the concrete 12, which is solid and continuous over and from side to side of the stringers or girders, or in other words, the entire floor 12 is of one piece of monolithic form with no joints or seams throughout its entire area. Reinforcing bars 30 are preferably provided at intervals throughout the length of each stringer or longitudinal reinforcing member 20, these bars 30 being inserted through apertures in the upright web of the T-iron 30; and embedded in the concrete 12.

In addition to the longitudinal stringers or girders 20, the floor is further reinforced longitudinally by bars 31 located immediately under and securely wired to the pipes 24 as indicated at 32, the number and spacing or the size of said bars throughout the length of the floor being preferably varied in accordance with the diminution of contraction and expansion strains toward the ends of the floor, as for example, in the present structure there are ten substantially equally spaced bars 31 between each adjoining pair of stringers or girders 20 and extending outwardly at each side of the longitudinal center line A—A substantially to the line B—B, while between the line B—B and the line C—C the number of bars 31 is reduced to 8 and the spacing correspondingly increased and between the lines C—C and the respective end of the rink floor the number of bars 31 is reduced to 6 and the spacing thereof correspondingly increased, this arrangement of said bars being shown in Fig. 1 in the broken away portion of the floor immediately below the line D—D which represents the transverse center line of the floor. An edge reinforcing bar 33, which is arranged substantially at the same level as the bars 31, is also provided which extends entirely around the floor and is embedded in the edge thereof.

Immediately above the pipes 24 and also embedded in the floor 12 and extending throughout the entire area thereof, is a wire mesh 34 of galvanized wire, the longitudinal and transverse wires of which are preferably spaced apart a distance of approximately six inches, and this floor is preferably completed with a finish surface 35 of terrazo or the like which should have the same ratio of mixture content, water and aggregate as the floor 12 so as to expand and contract similarly therewith.

The pipes 24 which extend entirely across the floor 12 and have the ends, which project beyond the edges of the floor, connected with headers 36 at one side and 37 at the other side of the floor, serve as a transverse reinforcing while the girders 20 and bars 31 reinforce the floor longitudinally and form a rigid floor structure which by reason of the fact that the floor merely rests on the supports 14, edge wall 15 and the sand filler 13 and is free to move thereon, is capable of ex-

panding and contracting without resisting strains and is held together by the pipes and other reinforcing in a permanent monolithic form free from the tendencies of previous floors to crack and break down.

The pipes 24 are arranged in batteries with a header 36 at one end and a header 37 at the other end of each battery of pipes, said headers and connections being located in trenches 38 and 39 respectively which extend along the sides of the floor and contain the mains 40 and 41 for supplying and removing the cooling medium which in practice may be and is supplied at times from one side and at other times from the other side of the floor, although for convenience in distinguishing same the side where the main 40 is located will be considered hereafter as the inlet or supply side and the other as the outlet or discharge side.

The headers 37 at what is termed the "outlet" side of the floor are at substantially the same level as the pipes 24 and have the latter directly connected therewith as shown in Fig. 2, each of said headers being connected by an expansion bend or elbow 42 with the main 41 which leads to the return pipe 43 in the trench 44 through which connections are made with the refrigerating apparatus. Said main 41, which is supported in any convenient manner, as for example by hangers 45, is stepped down in size at intervals from the connected end according to the relative capacity of the pipes 24 that are served thereby, as for example, in the present structure, the pipe 41 at the end adjoining the pipe 43 is 8 inches in diameter throughout the length of the first 19 connections 42, then stepped down to 6 inches in diameter for the distance of the next 9 connections, then 5 inches in size for the distance of the next 6 connections and then 4 inches in size for the last 4 connections.

The headers 36 at the so-called inlet side of the floor are positioned below the ends of the pipes 24 as shown in Fig. 3 each of said pipes being provided at the end with a T-fitting 46 having a removable plug 47 affording access to the respective pipe for cleaning and each fitting 46 is individually connected by a pipe 48 and coupling 49 with a header 36 which is in turn connected by an expansion elbow 50 with the supply main 40. This supply main 40 which is mounted in any convenient manner as for example on supports 51, is connected at the end 52 remote from the trench 44 with a return pipe 53 which is also mounted on supports 51 and leads back through the trench 38 to a cross pipe 54 in a transverse trench 55 to the pipe 56 which is in the trench 44 and connects with the refrigerating apparatus and said supply main 40 is also stepped down in size from the end 52 at intervals in like manner to the outlet main 41. Thus the intake 40 starts in at the corner of the floor remote from the source of supply of the cooling medium and is reduced in size as connections are taken off therefrom so as to insure a uniform distribution of the cooling medium to all the intake headers 36, and the outlet leads from the corner of the floor nearest the source of supply and is likewise reduced in size as outlet connections are made therewith so as to insure a uniform outflow from the outlet headers 37 and by reason of this opposite corner connection of the supply and outlet mains and the gradual reduction in size of the said mains, a substantially uniform capacity for circulation is not only provided for each battery of pipes but the same length of avenue of circulation is provided to and from each battery of pipes so that uniform circulation through all batteries of pipes is assured.

Moreover, to complete the uniformity of circulation, even through the individual pipes of each battery I make the connection of the supply main 40 with all the intake headers 36 at the ends of the latter farthest from the source of supply of the cooling medium (that is, farthest from the trench 44) and I make the connections of the outlet main with all the outlet headers 37 at the ends of the latter nearest to the source of supply, as in Patent No. 1,186,137 to Scott, so that the avenue of circulation through each individual pipe 24 of the entire floor, from the header inlet to the header outlet is exactly the same, and thus insures uniform circulation through each individual pipe of each battery as well as uniform circulation through each battery. This arrangement of the piping headers and mains is very important as it accomplishes automatically and with certainty and without the multiplicity of individual pipe valves which others have found it necessary to employ, uniform application of the cooling medium throughout the entire area of the floor and not only avoids differences in temperature at proximate places with resulting unequal expansion or contraction but it also keeps the temperature of the ice uniform and prevents melting and softening of the ice which occurs at places throughout the floor if the circulation of the cooling medium is not even and uniform.

The expansion elbows or loops 42 and 50, which serve to provide a yielding connection between the mains and the floor so that the latter is free to expand both transversely and longitudinally, are alike and of an improved construction permitting ease of installation, ready adaptability to contractional and expansional movement of the floor and freer and more uniform circulation. Each of these elbows or loops, as shown particularly in Figs. 6 and 7, consists principally of a length of lead pipe 57 which is bent in a U-shape somewhat as shown in Fig. 6, and has

one end connected to the respective header 36 or 37 through nipples 58 and 59 and elbow 60 and the other end connected to the respective main 40 or 41 through the valve 61, nipples 62 and elbow 63. The nipple 58 which is next to the pipe 57 and the end of the valve 61 next to said pipe are each provided with a common coupling flange 64 and for the purpose of providing a simple, convenient and effective means for connecting the ends of the pipe 57 therewith, I preferably provide each end of the latter with a coupling flange 65 which has a central opening 66 to receive the end of the pipe 57 which is swaged outwardly around the opening 66 and against the outer face of the coupling flange 65 as indicated at 67 so that when this coupling flange 65 is connected with a coupling flange 64 in the usual manner by bolts engaged through the bolt holes 68, the flared portion 67 of the lead pipe serves as a gasket which is clamped between the coupling flanges 64 and 65 and seals the joint. The use of the lead pipe loop for the connections between the headers and mains is very advantageous as it not only is easily shaped and fitted in place without the necessity of accurate cutting, threading and fitting together of the usual pipe connections and is sufficiently pliable to adjust itself readily to any changes in shape or position that are required in the expansion and contraction of the floor, but it also insures greater freedom and uniformity of circulation as the length of pipe 57 and the number and arrangement of the fittings of each connection is exactly the same even in cases, as illustrated at the ends of the floor in Fig. 1, where the cross pipes are shortened up, on account of the shape of the floor, and a different form of connection is required between the headers and the mains.

In floors of this character it is customary to provide a surrounding curb to confine the water and ice on the floor and it is also desirable to provide seating space, passageways, etc., around the floor preferably at a uniform and slight elevation above the floor. This is accomplished in my construction by providing around the rink floor a marginal floor 69 of any desired width with the inner edge portion thereof extended over and resting upon the marginal edge of the rink floor in a manner to permit free relative movement of the two floors. This marginal floor which may be of any desired construction and made of wood, concrete or other material, has the inner edge extended over the marginal retaining wall 15 with the edge portion of the floor 12 between the upper edge of said wall 15 and the inner edge portion of the surrounding floor 69, and when the latter is made of concrete, special provision is required to avoid bonding of the concrete of the marginal floor 69 with the edge of the floor 12 and to insure the necessary slippage between the overlapping parts for free expansion and contraction of the floor 12. This may be conveniently accomplished in the concrete structure as shown in Fig. 4 by providing a facing 70 of metal, such as sheet zinc, on the underside of the overlying portion of the marginal floor 69, which rests on the top surface of the floor 12, or the terrazo facing 35 thereof, so as to permit the necessary slippage, said facing 70 preferably having the edges turned up and into the concrete of the marginal floor to secure the facing metal firmly thereto. The inner edge or curb portion of the concrete floor 69 also has a plurality of reinforcing bars 71 embedded therein which extend around the rink floor and they are engaged in the hook-like inner ends 72 of the rods or reinforcing bars 73 which extend outwardly through the floor 69 so as to anchor said inner edge or curb portion securely to the remainder of the marginal floor, and these bars also serve to reinforce the floor 69 which is built over and forms the top wall of the trenches at the sides and ends of the rink floor. This marginal floor may be covered with a layer 74 of linoleum or any desired floor covering material, and on the underside and over the trenches is preferably lined with cork 75 or other insulating material to conserve the cold temperature in the trenches and minimize the undesirable cooling of the floor surface thereabove.

As before indicated, it is preferred to have the marginal floor 69 around the rink floor at a uniform level and elevated only a sufficient distance above the rink floor 12 to provide a satisfactory marginal curbing, this being desirable so that the marginal floor 69 is easily accessible at any place around the rink floor and all portions thereof may therefore be conveniently used for spectator space, passageways to and from the rink floor and other similar purposes. With many types of installations the mains and other connections are arranged so that they extend to such an extent above the level of the rink floor that desirable space around the rink floor is sacrificed for the purpose and a surrounding marginal floor at a uniform conveniently low elevation can not be provided. With my construction, however, this desirable and important result is accomplished as the main 40 and connections at the inlet side of the rink are well below the floor level as shown in Fig. 3 while at the outlet side the main 41 and connections are arranged as shown in Fig. 2 so that they may be located substantially at the rink floor level, the branches or leads from the outlet main 41 being arranged at or near the top thereof as indicated at 76 in Fig. 2 so as to permit the location of the marginal floor at the desired low level.

In rinks of this character it is oftentimes desirable to have a railing around the rink floor with openings or passages therethrough for the patrons to enter and leave the floor, and this railing should be removable as the floor is frequently used for purposes wherein a railing around the floor is not desired. This is accomplished in my construction by making the railing, a fragmentary lower portion of which is indicated herein at 77 in sections with posts 78 at intervals, the lower ends of which said posts engage in sockets provided therefor in the curbing portion of the marginal floor 69. These sockets, which are preferably located close to the face of the curbing, comprise tubular socket members 79 which open through the top of the curbing portion and extend to the bottom thereof, and are arranged at suitable intervals along the curbing. For anchoring these socket members securely in the curbing they are provided near their upper and lower ends with outwardly extending arms 80 and laterally extending arms 81 which are welded or otherwise attached to the tubular members 79 and when embedded in the concrete these arms 80 and 81 hold the socket members permanently in place. The inner face of the curb is preferably protected with a metal facing 82 as shown in Fig. 4 and an angle iron 83 may be provided along the upper edge with the linoleum 74 or other floor covering extended under and held in place by the top flange of the angle iron and the railing 77 may be provided with a floor plate 84 along the bottom which rests on the floor covering 74 when the posts 78 are fully inserted in their sockets 79, thereby giving the railing a substantial, permanent and finished appearance.

In constructing this floor, the surrounding retaining wall 15 is first installed with the facing 17 arranged in place in the top thereof, after which the ground is removed, if necessary and leveled off to the required depth below the top of the wall 15 to accommodate the layer 13 of sand. The pre-cast blocks 14, which are provided merely to insure proper support of the piping until the concrete is poured, are then placed in position, the earth being preferably hollowed out slightly at each block location as indicated at 85 and filled in with soft concrete 16 to form a footing, said blocks being set so that the top faces thereof are at substantially the same elevation as the top surface of the surrounding wall 15. After the footings 16 have set, the plates 19 are placed on the blocks 14 and the longitudinal stringers and pipe supports 20, with their reinforcing bars 30, set in place and said stringer sections connected up with their joints located over blocks 14. The sand layer 13 which may be filled in at any time, either before or after the installation of the stringers 20, is leveled off, preferably slightly above the upper surfaces of the plates 19 of the blocks 14 and the facing 17 of the wall 15 and with a little slope downwardly thereto as indicated at 86 in Fig. 4. The pipes 24 are then set in place in the seats 23 of the stringers 20 and connected up with their inlet headers 36, and the reinforcing bars 31 and 33 placed in position, the former being wired securely to the underside of the pipes 24. The wire mesh 34 is then laid upon the pipes 24, and a suitable form having been built around the wall 15 at the top to confine the edge of the floor, the concrete 12 is poured in place and leveled off with the top surface thereof well above the pipes 24 and all other members such as stringers, reinforcing members and the like that are incorporated in the flooring, so that the concrete forms an integral monolithic slab without any joints or seams throughout the entire area of the floor. The facing plate 17 on the wall 15 is covered with waxed paper before the concrete is applied thereover, so as to prevent adhesion or bonding of the newly poured concrete with the facing plate 17. The pouring of the concrete 12 is followed up immediately with the laying of the terrazo 35 or other surface covering.

While the floor composition may be made of any material suitable for the purpose, it is very important that the materials and the proportions thereof are the same throughout the entire area of the floor as variations in material or mixture at places throughout the floor are likely to result in different expansion and contraction characteristics which introduce stresses and strains that will ultimately cause cracks. With the floor reinforced and supported as above indicated and a suitably uniform composition employed, and the piping arranged as above described to insure uniformity of temperature throughout the entire floor, a rigid and permanent monolithic floor results with adequate provision for slippage to accommodate the severest expansion and contraction without affecting the unity of the floor structure. Therefore, as seams and expansion joints are not employed and as the floor is constructed so that cracks do not occur, and as cracks, seams and expansion joints, as above pointed out, are the principal causes of disintegration and breaking down of ice rink floors, the objectionable features of previous floors are avoided and an ice rink floor is provided which will withstand long usage without any detrimental effects.

After the floor has been completed as above indicated and the composition has thoroughly set, the marginal floor 69 is built so as to extend over the marginal edge of the rink floor without any binding or restraining action which would interfere with the expansion and contraction of the rink floor. In constructing the marginal floor 69 of concrete

as illustrated herein the metal plate 70 is located in position on the edge of the floor 12 above the wall 15, the reinforcing bars 71 and 73 and socket members 79 located and held in place, and with suitable forms arranged to confine the concrete over the floor 12 to the surface of the metal plate 70, the latter will be anchored in the concrete of the floor 69 and afford a facing on the underside thereof which slidingly engages the top surface of the floor 12 and permits the necessary relative movement between the floors 12 and 69 for expansion and contraction.

In cases such as hereinbefore pointed out, where the rink is located on an upper floor or above a basement or where it is necessary to remove and replace the ice frequently or quickly, special insulation is desirable on the underside of the floor to avoid migration of temperature changes downwardly with its undesirable effect on the atmosphere of the rooms below or the resulting loss of time, particularly in cooling the floor, and when such special insulation is required this may be accomplished in the manner illustrated in Figs. 10 and 11.

In this construction a concrete base 87 is provided either on the ground or at the elevation in the building where the ring is to be located, and if a surrounding wall is employed this merely extends up to the level of the upper surface of the base 87 as indicated at 88 in Fig. 11. After this has been completed, the top surfaces of the base 87 and wall 88 are mopped with hot asphalt and one or more layers 89 of cork, laid thereover so as to extend out over the wall 88 as shown in Fig. 11, the blocks of cork composing the layers being mopped with the hot asphalt to bond and seal the cork blocks in place. After the top surface of the upper layer 89 of cork has been thoroughly mopped with hot asphalt a thin layer 90 of cold asphalt or asphalt emulsion is applied thereon and covered with a layer 91 of asbestos paper after which the entire surface is rolled down flat and smooth. A layer 92 of sheet zinc is then laid over the asbestos 91 and upon this zinc layer the stringers 20 are located and the floor 12 built up with pipes 24, reinforcing 31, 33, 34 and the concrete poured and facing 35 provided in the same manner that the floor is constructed in the form of installation illustrated in Fig. 4. In other words, the structure above the zinc facing 92 in the structure of Figs. 10 and 11 and including the marginal floor 69, is the same as the structure of Fig. 4 above the sand layer 13 and cap plates 17 and 19, the stringers 20 and concrete in the insulated structure of Figs. 10 and 11 being placed directly on the upper surface of the zinc facing 92 which latter adheres to the concrete of the floor 12 and provides an under surface therefor which permits the floor to expand and contract freely on the smooth surface of the asbestos layer 91.

With this construction of Figs. 10 and 11, the cork layers 89 afford insulation to prevent downward migration of temperature changes from the rink floor 12 and thereby restrict the zone of temperature changes and minimize the mass of material which must be warmed to remove the ice from the floor and cooled to replace the ice, and removal and replacement of the ice so that the floor may be optionally used for skating or other purposes is accomplished more economically and in less time than with floors in which an insulating base is not provided.

While I have shown and described my invention in a preferred form, I am aware that various changes and modifications may be made therein, and that certain features thereof may be employed in connection with floors other than those which are intended for ice rink purposes, without departing from the spirit of my invention, the scope of which is to be determined by the appended claims.

I claim as my invention:

1. In an ice skating rink floor structure the combination of a plurality of laterally spaced stringers, a plurality of closely adjoining pipes supported by the stringers, a one piece monolithic composition slab extending throughout the entire area of the skating floor and having the pipes and stringers embedded therein, and supporting means on which the slab is horizontally movable.

2. In an ice skating rink floor structure the combination of a plurality of rows of supports, a stringer slidably mounted on each row of supports, a plurality of pipes supported by and extending transversely over the stringers and a composition slab having the pipes and stringers embedded therein.

3. In an ice skating rink floor structure the combination of a plurality of laterally spaced stringers extending longitudinally of the floor, a plurality of pipes mounted on the stringers and extending crosswise of the floor, longitudinal reinforcing bars adjacent the pipes and between the stringers and a composition slab having the pipes and stringers and reinforcing bars embedded therein.

4. In a skating rink the combination of an ice supporting floor, said floor comprising a one piece monolithic composition slab extending throughout the entire area of the skating floor, laterally spaced stringers embedded in the bottom portion of the slab, a plurality of closely adjoining pipes on and extending transversely over the stringers and embedded in the slab, and laterally spaced reinforcing bars between the stringers and extending lengthwise thereof and embedded in the slab.

5. In a skating rink, the combination of

an ice supporting floor comprising a one piece monolithic composition slab, and a curb extending around and resting on the edge portion of the monolithic slab, said curb being loose from the slab to permit expansion and contraction of the slab independently of the curb, said floor being provided with a plurality of horizontal passageways therein with connections through which a medium is supplied to said passageways for cooling the surface of the floor to an ice forming temperature.

6. In a skating rink the combination of an ice supporting composition floor, a curb extending around and resting on the edge portion of the floor, said curb being loose from the floor to permit expansion and contraction of the floor independently of the curb, and a metal facing between the floor and curb affording a sliding connection therebetween for relative movement of the floor and curb, said floor being provided with a plurality of horizontal passageways therein with connections through which a medium is supplied to said passageways for cooling the surface of the floor to an ice forming temperature.

7. In a skating rink the combination of an ice supporting composition floor, a wall extending around and having the edge portion of the floor resting thereon, a curb extending around and resting on the edge portion of the floor, and a metal facing between the floor and the top face of the wall and between the floor and the bottom face of the curb affording a sliding connection permitting the floor to expand and contract independently of the wall and curb, said floor being provided with a plurality of horizontal passageways therein with connections through which a medium is supplied to said passageways for cooling the surface of the floor to an ice forming temperature.

8. A monolithic ice rink floor of solidified cementitious material having a multiplicity of laterally spaced substantially parallel horizontal passageways therein, means for distributing to said passageways a medium for cooling the surface of the floor to an ice producing temperature, and a base on which said floor is movably supported for independent expansion and contraction, said rink floor being unitary and seamless throughout its entire ice producing surface and having embedded therein reinforcing means which extend transversely to said passageways and bond together the portions of the floor at opposite sides of said passageways throughout substantially the entire ice producing area of the rink floor.

9. A monolithic ice rink floor of solidified cementitious material having a multiplicity of laterally spaced substantially parallel horizontal passageways therein, means for distributing to said passageways a medium for cooling the surface of the floor to an ice producing temperature, and a base on which said floor is movably supported for independent expansion and contraction, said rink floor being unitary and seamless throughout its entire ice producing surface and having embedded therein reinforcing means which extend transversely under said passageways and bond together the portions of the floor at opposite sides of said passageways throughout substantially the entire ice producing area of the rink floor.

10. A monolithic ice rink floor of solidified cementitious material having a multiplicity of laterally spaced substantially parallel horizontal passageways therein, means for distributing to said passageways a medium for cooling the surface of the floor to an ice producing temperature, and a base on which said floor is movably supported for independent expansion and contraction, said rink floor being unitary and seamless throughout its entire ice producing surface and having embedded therein reinforcing means which extend transversely under said passageways and bond together the portions of the floor at opposite sides of said passageways throughout substantially the entire ice producing area of the rink floor, said reinforcing means being located substantially midway between the top and bottom surfaces of the floor.

11. A monolithic ice rink floor of solidified cementitious material having embedded therein a multiplicity of horizontal closely arranged parallel pipes, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, and a base on which said floor is movably supported for independent expansion and contraction, said rink floor being unitary and seamless throughout its entire ice producing surface and having embedded therein under said pipes and substantially midway between the top and bottom surfaces of the floor, reinforcing bars which extend transversely to the pipes and bond together the portions of the floor at opposite sides of the pipes throughout substantially the entire ice producing area of the rink floor.

12. A monolithic ice rink floor of solidified cementitious material having embedded therein a multiplicity of horizontal closely arranged substantially parallel pipes, a base on which said floor is movably supported for independent expansion and contraction, said rink floor being unitary and seamless throughout its entire ice producing surface and having embedded therein reinforcing means which extend transversely to said pipes and bond together the portions of the floor at opposite sides of said pipes throughout substantially the entire ice producing area of the rink floor, supply and discharge ducts along the floor adjacent the ends of

the pipes, a plurality of connections between the said ducts and the pipes for distributing to and circulating through said pipes a medium for cooling the surface of the floor to an ice producing temperature, said connections being of a readily bendable material permitting relative shifting of the floor pipes and ducts as the floor expands and contracts.

13. An ice rink floor having embedded therein a multiplicity of horizontal closely arranged substantially parallel pipes, a base on which said floor is movably supported for independent expansion and contraction, supply and discharge ducts along the floor adjacent the ends of the pipes, a plurality of connections between the said ducts and the pipes for distributing to and circulating through said pipes a medium for cooling the surface of the floor to an ice producing temperature, said connections being of a lead like material and suitably bent to provide a readily yielding connection permitting relative movement of the floor pipes and ducts as the floor expands and contracts.

14. A monolithic ice rink floor of solidified cementitious material having embedded therein a multiplicity of horizontal pipes arranged in substantially parallel relation, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, and a base on which said rink floor is substantially uniformly supported throughout substantially its entire area for independent expansion and contraction, said rink floor being unitary and seamless throughout its entire ice producing surface and having embedded therein under the pipes substantially horizontal members which extend transversely to the pipes and bond together the portions of the floor at opposite sides of said pipes throughout substantially the entire ice producing area of the rink floor.

15. A monolithic ice rink floor of solidified cementitious material having a multiplicity of horizontal pipes embedded therein, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a curb around the floor, and a base on which said floor is movably supported throughout substantially its entire area for independent expansion and contraction, the entire rink floor within the area defined by said curb being unitary and seamless and having embedded therein substantially horizontal reinforcing members which extend transversely to the pipes and bond together the portions of the floor at opposite sides of said pipes throughout substantially the entire floor within the curb.

16. An ice rink floor of solidified cementitious material having a multiplicity of closely arranged substantially parallel horizontal pipes embedded therein, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a base on which said floor is movably supported for independent expansion and contraction, and bearing means of sheet metal interposed between the floor and base to facilitate relative sliding movement of the floor and base.

17. An ice rink floor of solidified cementitious material having a multiplicity of closely arranged substantially parallel horizontal pipes embedded therein, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a base on which said floor is movably supported for independent expansion and contraction, and a sheet metal facing on the under side of the floor and having a sliding engagement with the base.

18. An ice rink floor of solidified cementitious material having a multiplicity of closely arranged substantially parallel horizontal pipes embedded therein, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a base on which said floor is movably supported for independent expansion and contraction, and a sheet metal layer interposed between and slidably supporting the floor on the base.

19. An ice rink floor of solidified cementitious material having a multiplicity of closely arranged horizontal pipes embedded therein in substantially parallel relation, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a base of insulating material on which said floor is movably supported for independent expansion and contraction, and a layer of sheet metal interposed between the floor and insulating base.

20. In an ice rink floor the combination of a permanent base, sheet metal bearing means slidable on the base, and a floor of solidified cementitious material molded on the sheet metal bearing means, said floor having a plurality of closely arranged horizontal pipes embedded therein in substantially parallel relation, and means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature.

21. In an ice skating rink floor structure the combination of a base of thermal insulating material, a composition floor mounted on the said base and having a plurality of closely arranged horizontal pipes embedded therein in substantially parallel relation, means for uniformly distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, and a layer of sheet metal between and providing a sliding face permitting relative hori-

zontal movement of the base and composition floor.

22. An ice rink floor of solidified cementitious material having a multiplicity of closely arranged substantially parallel horizontal pipes embedded therein, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a base on which the floor is movably supported for independent expansion and contraction, and a layer of sheet material between and by which the floor is slidably supported on the base.

23. An ice rink floor of solidified cementitious material having a multiplicity of closely arranged substantially parallel horizontal pipes embedded therein, means for distributing to said pipes a medium for cooling the surface of the floor to an ice producing temperature, a base on which the floor is movably supported for independent expansion and contraction, a layer of sheet material between and by which the floor is slidably supported on the base, and pipe supporting members embedded in the floor and located between the layer of sheet material and the pipes.

MARTIN R. CARPENTER.