May 12, 1970 N. B. POPIL 3,510,996

RETRACTABLE COVERING

Filed March 17, 1966 2 Sheets-Sheet 1

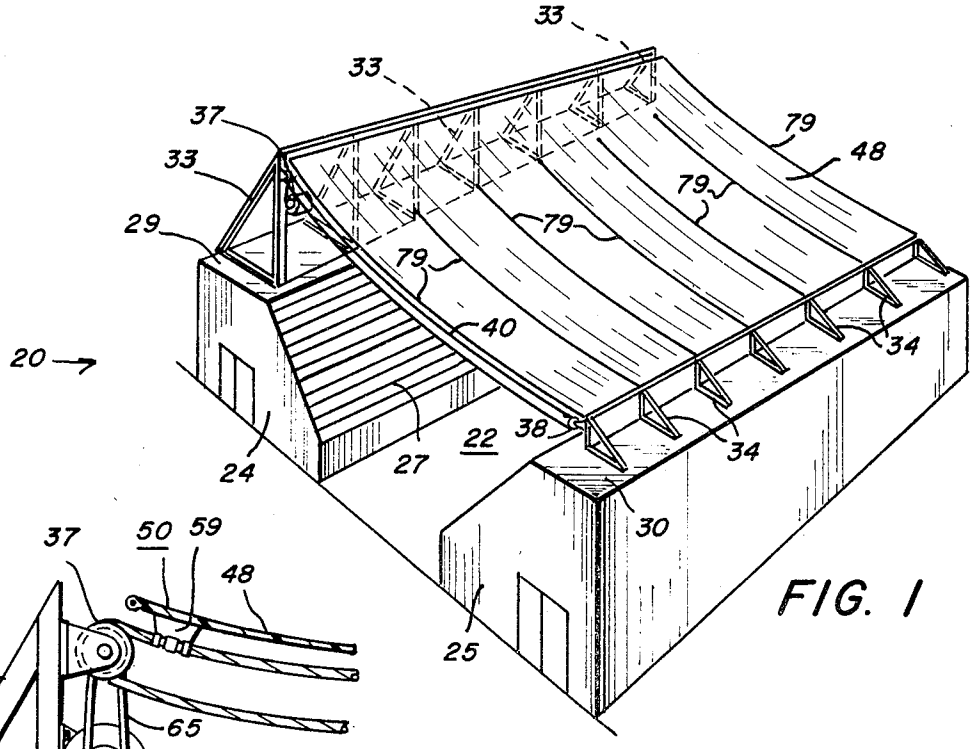



FIG. 1




FIG. 3

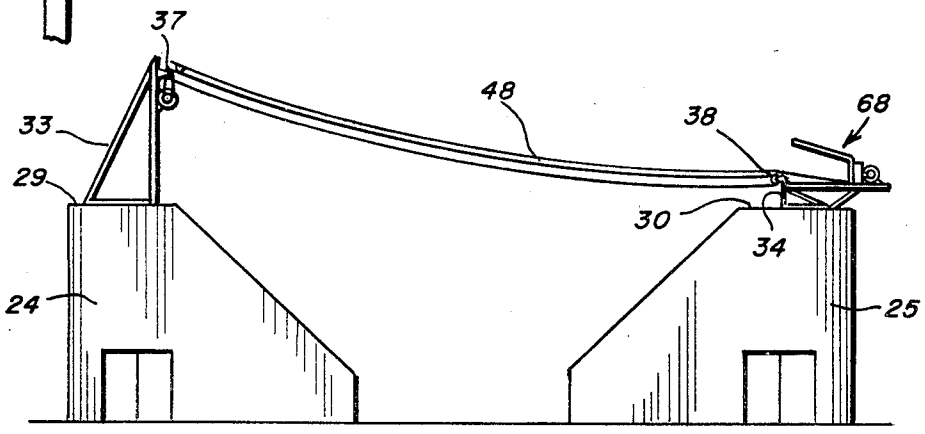



FIG. 2

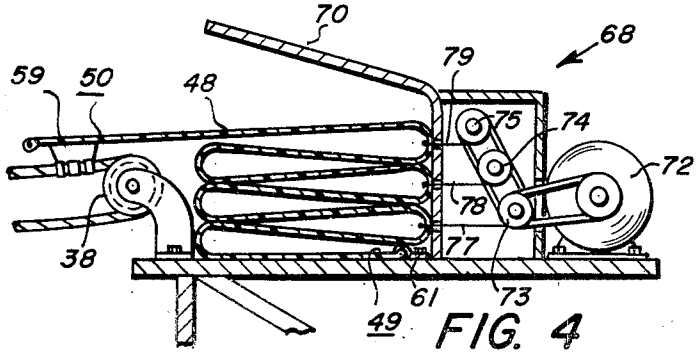



FIG. 4

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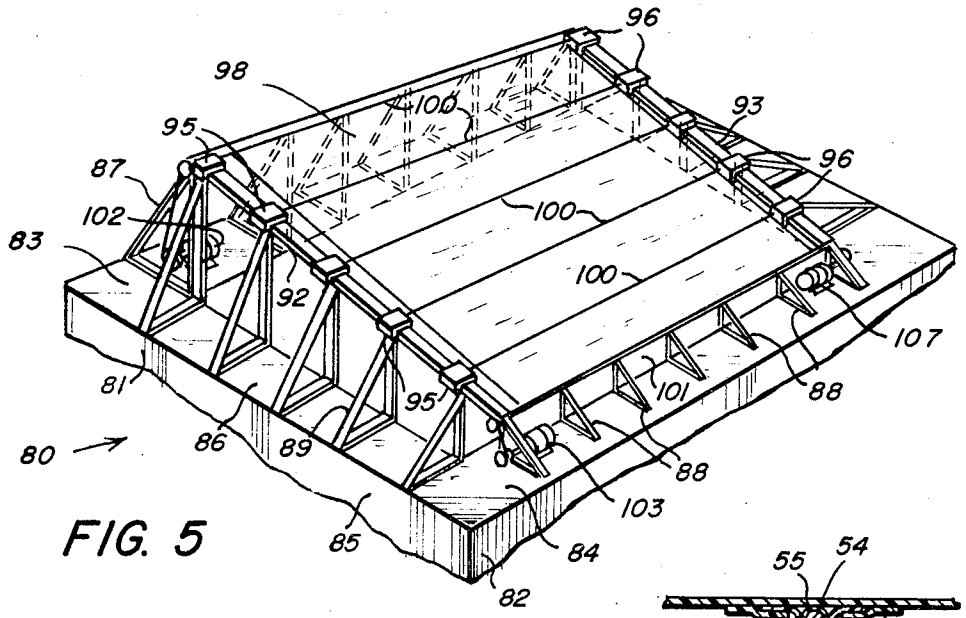



FIG. 5




FIG. 8

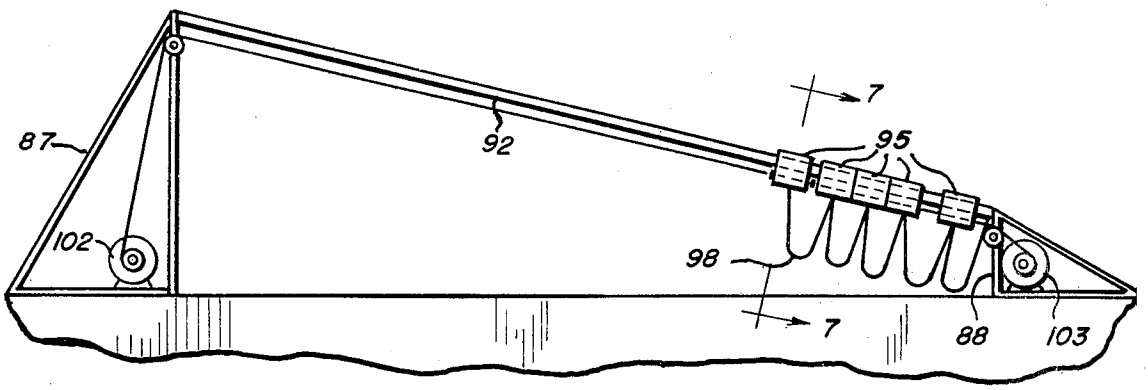



FIG. 6

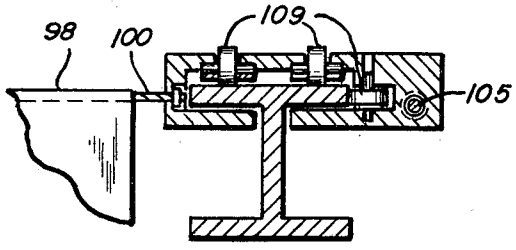



FIG. 7

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3,510,996

# RETRACTABLE COVERING

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U.S. Cl. 52—64 4 Claims

## ABSTRACT OF THE DISCLOSURE

Apparatus for covering a relatively large open area from inclement weather which large area is defined at least partially by vertical extending wall structure. The apparatus includes a cover member which has a first side portion fixedly connected to one portion of the wall structure and cable means are connected to the cover member at a second side portion. Motive transfer means are connected to the cable means and are movable in first and second directions to alternately move the second side portion of the cover member between open and closed positions. Motor drive means cooperate with the structure for moving the motive transfer means.

## SUMMARY

The invention is directed to covering large open areas such as sports stadiums so that contests which are conducted therein can be continued without the usual interruptions of inclement weather. The present invention provides structure where the cover is inclined at an acute angle to aid in the drainage of water and is conveniently constructed so that it can be readily opened and closed.

The present invention relates in general to a roof construction and more particularly to a roof construction which can be utilized for the purpose of covering areas such as stadiums, arenas, open topped building structures or storage and manufacturing areas, which roof can be moved from an open position where the area is exposed to the weather elements to a closed position wherein the area is shielded from the weather elements.

As an example of the utility of the present invention one may take the case of sports arenas such as those presently utilized in the playing of college or high school baseball and football. Most of these stadiums comprise vertically extending wall structure which rise to a given height which wall structure may extend around or partially around the playing field in a conventional manner and which includes seating for spectators. The upper portion of the wall structure usually terminates in what is commonly referred to as a roof, however, the comparatively large area between the wall structure is exposed at all times to the weather elements.

Provision has been made in some prior art structures to provide a permanent closure or roof over this hereinbefore uncovered area and this permanent roof has included in some instances transparent portions in the nature of glass or plastic members, however, this construction is generally of a permanent nature. Many disadvantages have arisen with this type of structure such as glare from the sun resulting in players of a sport being momentarily blinded by the sun. Another disadvantage has been the inability of a player to properly follow a rapidly moving ball which alternately passes a support structure and a transparent or translucent member. When the transparent closures have been painted or otherwise treated to keep the sun out, difficulties have been encountered in trying to keep the grass on the playing field from dying.

The prior art has also utilized in some instances a roof structure for this area which generally is of a permanent type construction but which can partially be uncovered by the rotation of various elements with respect to each other in a generally angular direction.



The present invention seeks to obviate the disadvantages in any of the hereinabove described prior art structures by providing a roof or closure member which can be readily opened and closed depending upon the weather conditions exteriorly of the structure.

Another object of the present invention is to provide a roof closure construction whereby the closure mechanism utilized includes cable means for drawing the cover member between open and closed positions and also where rails are provided for drawing the cover member between open and closed positions.

Another object of the present invention is to provide a mechanism for folding the cover member when the cover member is moved to an open position in uncovering an area.

Another object of the present invention is to provide a cover member for covering a playing field or other uncovered area which comprises a high strength plastic material which is translucent in nature and which is sufficiently reinforced to withstand any span which it must extend over.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an isometric view of a sports stadium showing the roof closure of the present invention in a closed or covered condition;

FIG. 2 is an end elevational view of the stadium shown in FIG. 1;

FIG. 3 is an elevational view showing a detail of a portion of the construction shown in FIG. 2, namely the left end of the cable with the means for driving the same;

FIG. 4 is a further detail of the construction shown in FIG. 2 and illustrating the means for folding the cover member as it is moved to open position;

FIG. 5 is a fragmentary isometric view illustrating a modification of the roof closure shown in FIG. 1;

FIG. 6 is an elevation of the structure shown in FIG. 5;

FIG. 7 is a view taken generally along the line 7—7 of FIG. 6; and

FIG. 8 is a cross section taken through the cover member illustrating a means of connecting reinforcing cables to the cover member to give the cover member further support when desired.

As mentioned hereinabove, the roof closure is susceptible of a variety of uses, however, in the embodiment illustrated herein the area to be covered has been shown as a sports stadium **20**. This stadium **20** includes a playing field **22** upon which the participants of a particular game pursue the same, and the stadium includes vertically extending wall structure identified by the reference numerals **24** and **25**. In the embodiment shown the vertical wall structures **24** and **25** extend generally parallel with each other with the playing field **22** residing therebetween and the ends of the structure have been shown as open. From the standpoint of practicing the present invention it is of little difference whether the ends are open or closed. The stadium also comprises conventional seats **27** for spectators.

The top of the vertically extending wall structures **24** and **25** terminate in roofs **29** and **30** respectively and mounted on the roof **29** are a plurality of truss structures **33** which extend to a given vertical height and mounted on the roof **30** are a plurality of truss structures **34**. Each of the truss structures on a given roof are connected together at their uppermost apex by means of a supporting member which serves to more structurally secure the truss structures of a given plurality together. The truss structures **33** are each provided with a pulley member **37** and each of the truss structures **34** are also provided with a

pulley member **38**. Extending between opposed pulley members **37** and **38** are continuous cables **40**, only one of which has been shown, however there are a total of seven, identical in construction.

A cover member **48** is provided with first and second end portions **49** and **50** respectively and this cover member may be generally described as a one-piece translucent member which may be made up of a plurality of pieces of material suitably secured together but which when completed is preferably of a one-piece construction. The particular construction of the cover member may be varied substantially, however the fabric may be nylon and/or Dacron covered for example with a vinyl or a neoprene rubber. For the sake of example the material should have a comparatively high tensile strength, preferably over 200 pounds per square inch, and should be, as mentioned before, translucent. The material should have a low moisture absorption factor, preferably less than 5% of the fabric weight and should comply with the cold snap test when used in northern climates to −40° F. The construction should also include anti-ozone compounds for protection from the ultra-violet rays of the sun and the material should be comparatively light weight, for example it should weigh in the range of from 10 to 70 ounces per square yard. The material should be fire-resistant to meet Federal Regulation CCT–191B Method 5910. The cover member **48** may have, for the sake of reinforcing the same, a plurality of cables running therethrough in any given pattern. FIG. 8 serves to demonstrate how such reinforcing cables are secured to the cover member. In this preferred construction the reinforcing cable **54** is housed in a plastic pipe **55** held in position to the cover member by a fabric piece **56** which fabric piece **56** has its ends secured to the cover member by means of fabric pieces **57** at either end thereof.

The first end portion **49** of the cover member **48** is suitably fixedly secured along the side that corresponds to the vertically extending wall structure **25**, by means of a plurality of brackets **59** (FIG. 4) and the opposite end **50** of the cover member is secured to each of the cables **40** by means of brackets **61**.

A drive motor **63** is mounted by each of the truss structures **33** (FIG. 3) and is adapted to drive the pulley members **37** by way of a belt **65**. The drive motors **63** are reversible and may serve to drive the cable to which it is operatively connected, in either of two opposed directions. All of the drive motors **63** are synchronized to operate together.

A folding mechanism **68** is located at the truss structures **34** and are for the purpose of folding the cover member **48** as the field is uncovered. There is a folding mechanism **68** located at each of the truss structures **34**, however, these have not been shown in FIG. 1 for more ease in illustrating the rest of the structure. The folding mechanisms each include a housing **70** with a vertically extending wall and a drive motor **72**, through a belt, serves to drive three sheaves **73**, **74** and **75**. The construction of the sheaves **73** through **75** is such that a clutch mechanism is provided between the axle and the sheave so that when the sheave meets sufficient resistance to rotation it will remain stationary relative to its axis so that the adjacent sheave will continue to be driven etc., until all of the sheaves have met sufficient resistance to rotation whereby they will no longer turn. Wind up cables **77**, **78** and **79** extend from sheaves **73**, **74** and **75** and are secured at equidistant positions to the cover member across its width. As a result when the cover member is retracted by actuation of drive motors **72** along with drive motors **63** which are synchronized therewith, the wind up cable **77** will be drawn through the opening in the wall of housing **70** until the bottom fold shown in FIG. 4 is produced therein and resistance to further movement of cable **77** is encountered. Cables **78** and **79** will continue to be drawn through their respective openings to produce the succeeding folds as shown in FIG. 4, until the cover member has reached an open position whereat appropriate limit switches are thrown thereby de-energizing motors **63** and **72**. In order to close the cover member the reverse procedure is gone through, namely, drive motors **63** are energized to travel in the opposite direction which pulls the cover member **58** across the playing field. In this direction of movement of the cover member the cables **77**, **78** and **79** do not exert a force tending to close the cover member, but simply are permitted to unwind to their extended positions.



FIGS. 5, 6 and 7 illustrate a modification of the invention shown in FIGS. 1 through 4 and in this embodiment there has been shown a stadium **80** which has vertically extending wall structures **81**, **82** and **85** which terminate in roofs **83**, **84** and **86** respectively. A similar wall structure is located opposite wall structure **86** but which has not been numbered. Truss structures **87** are mounted on roof **83**, truss structures **88** are mounted on roof **84** and truss structures **89** are mounted on roof **86** as well as the roof opposite **86**. It will be noted that the truss structures **87** extend to a greater vertical height than do the truss structures **88** and at opposed ends of the roofs there are provided tracks **92** and **93**. A plurality of sliders **95** are located on track **92** and a plurality of sliders **96** are positioned on track **93**. A cover member **98** is provided, of the same construction as cover member **48**, and this cover member is supported between the sliders **95** and **96** by means of cables all identified by the reference numeral **100**. These cables are secured to the cover member in a manner similar to that construction shown in FIG. 8 and are secured to each of the sliders as shown in FIG. 7. An end of the cover member is fixedly secured in position to a support member **101** which connects the apex of each of the truss structures **88**.

Drive motors **102** and **103** are provided at opposed ends of track **92** and are for the purpose of moving the sliders **95** between the position shown in FIG. 5 and the position shown in FIG. 6 to open and close the cover member. This is accomplished by means of a cable **105** which extends around a sheave or pulley at either end which pulleys are driven respectively by the drive motors **102** and **103**, and this cable **105** extends through openings in each of the sliders, however, is fixedly secured to the slider closest to drive motor **102**. This is the identical drive mechanism for moving the sliders **96** which travel on track **93** and only one drive motor **107** is seen in FIG. 5. All four of the drive motors are synchronized with each other to open and close the cover member and limit switches are provided at either end to de-energize the driving motors when the designed limits of the cover member have been traversed. FIG. 6 demonstrates in a somewhat schematic manner how the cover member **98** tends to fold when the cover member is moved to open position. FIG. 7 is a detail of construction of one of the sliders **95** which shows the connection of the support cables **100** with the slider members and also shows the construction of cable **105**. It will also additionally be noted that rollers **109** of suitable construction are utilized to aid the sliders in traveling in a relatively uninhibited fashion on the tracks with which they are associated.

It will be noted in the embodiments shown in FIGS. 1 and 5 that the truss structures on one side have been located at a higher elevation than the truss structures on the other side, which provides for the convenient escape of moisture usually in the form of rain water, by the action of gravity. In the event there is not sufficient drop for the cover member or in the event the cover member has a tendency to droop or bag out in spots so as to entrap water, it is possible to install sufficient duct work in cooperation with the cover member in order to transfer the moisture to the ground. It is also possible to make the roof closure slightly more weather proof than illus-

trated in the accompanying drawing by closing the spaces leading into the stadium between the truss structures and it is also possible to close the open ends of the stadium to some degree if desired. The sliders and tracks in FIG. 5 in combination with the drive motors and the drive motors and pulleys in FIG. 1 may all be generally referred to as motive transfer means.

It will thus be seen from reviewing the above disclosure that the primary object of conveniently covering a comparatively large area such as a stadium has been accomplished in an economical and inventive manner.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. Apparatus for covering an open area defined by vertically extending wall structure which extends at least partially around the open area and which has first and second sides, including in combination a first plurality of support structures secured to the top of said wall structure at said first side of the wall structure, a second plurality of support structures secured to the top of said wall structure at said second side of the wall structure, said first plurality of support structures being substantially higher than said second plurality, a first plurality of pulley members mounted on at least some of said first plurality of support structures, a second plurality of pulley members mounted on at least some of said second plurality of support structures, and being oppositely disposed with respect to the pulley members of said first plurality, cable members extending between respective pulley members of said first and second plurality, a cover member having a first side portion secured to the top portion of said second plurality of support structures and having a second side portion secured to said cable members, and motor drive means mounted on some of said support structures for moving said cable members to move said second side portion of said cover member back and forth between said first and second sides of the wall structure, said first and second plurality of support structures and pulley members mounting said cover member at an acute angle with respect to the ground to aid in the drainage of water therefrom.

2. Apparatus as claimed in claim 1 wherein folding means are located at said second plurality of support structures and including means for engaging said cover member wherein increment lengths are positioned generally horizontally and stacked on top of each other in a generally vertical direction.



3. Apparatus as claimed in claim 1 wherein folding means are located at said second plurality of support structures and include fold cables attached to said cover member at different positions across the length thereof whereby said fold cables when actuated causing said cover member to be folded with the folds extending generally horizontally and stacked generally vertically.

4. Apparatus for covering an open area from inclement weather, said open area defined by vertically extending wall structure which extends at least partially around and substantially above the open area and which has first and second sides, including in combination a first plurality of support structures secured to the top of said wall structure at said first side of said wall structure, a second plurality of support structures secured to the top of said wall structure at said second side of the wall structure, a first plurality of pulley members mounted on at least some of said first plurality of support structures, a second plurality of pulley members mounted on at least some of said second plurality of support structures, and being oppositely disposed with respect to the pulley members of said first plurality, cable means extending between respective pulley members of said first and second plurality, a cover member having a first side portion secured to the top portion of said second plurality of support structures and having a second side portion secured to said cable means, and drive means carried by said support structures for moving said cable means to move said second side portion of said cover member back and forth between said first and second sides of the wall structure.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 834,287 | 10/1906 | Frey | 160—193 |
| 1,407,248 | 2/1922 | Brown | 160—35 X |
| 1,728,074 | 9/1929 | Nicholas | 160—84 |
| 2,603,171 | 7/1952 | Smith | 52—66 |
| 2,754,900 | 7/1956 | Karobonik et al. | 160—84 X |
| 3,288,158 | 11/1966 | Gugliotta | 52—66 X |



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52—6, 83; 135—5; 160—35, 84