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G. W. HOUGH & W. SCHERZER.

ASTRONOMICAL DOME.

No. 416,364. Patented Dec. 3, 1889.

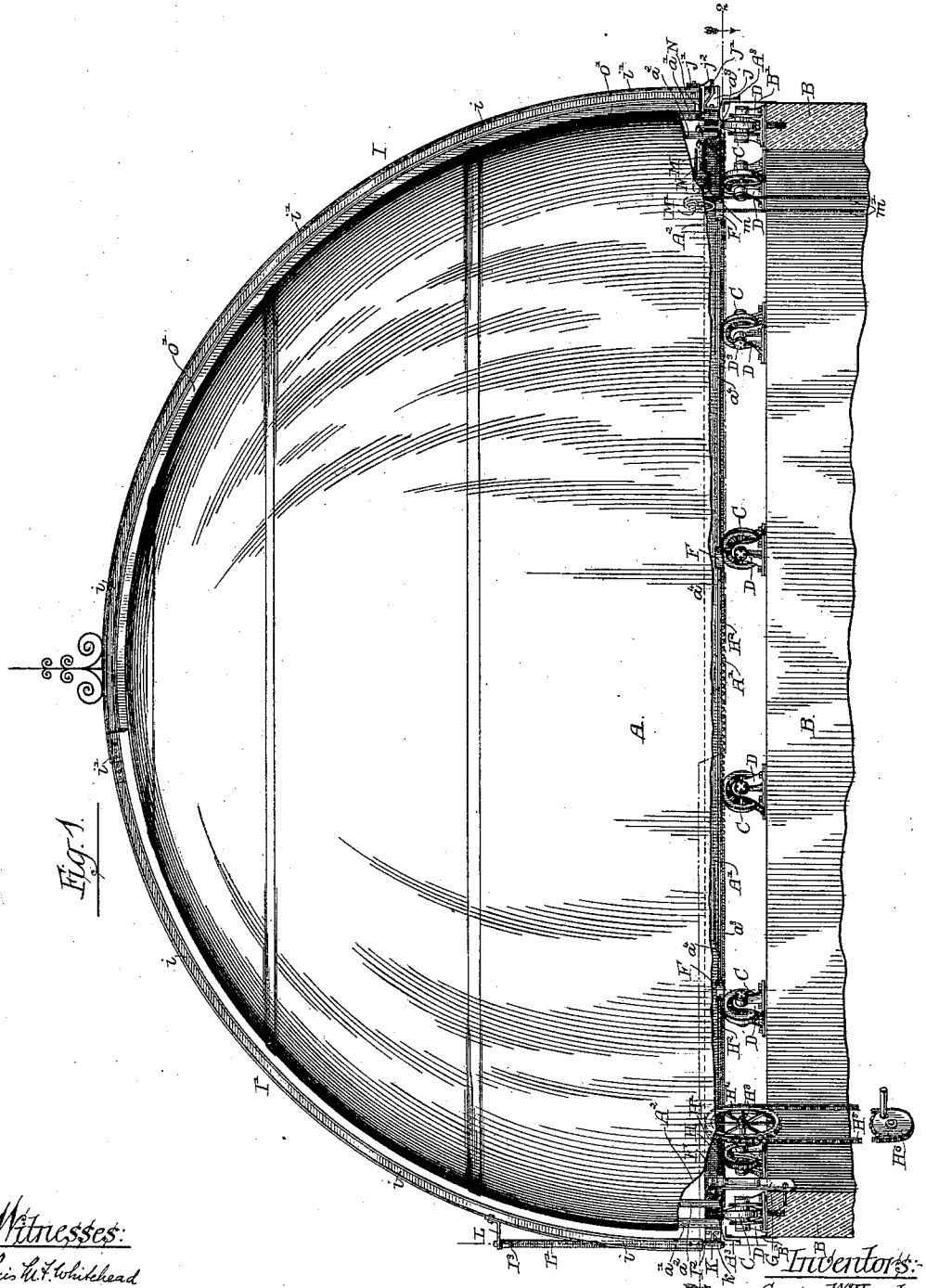


Fig. 1.

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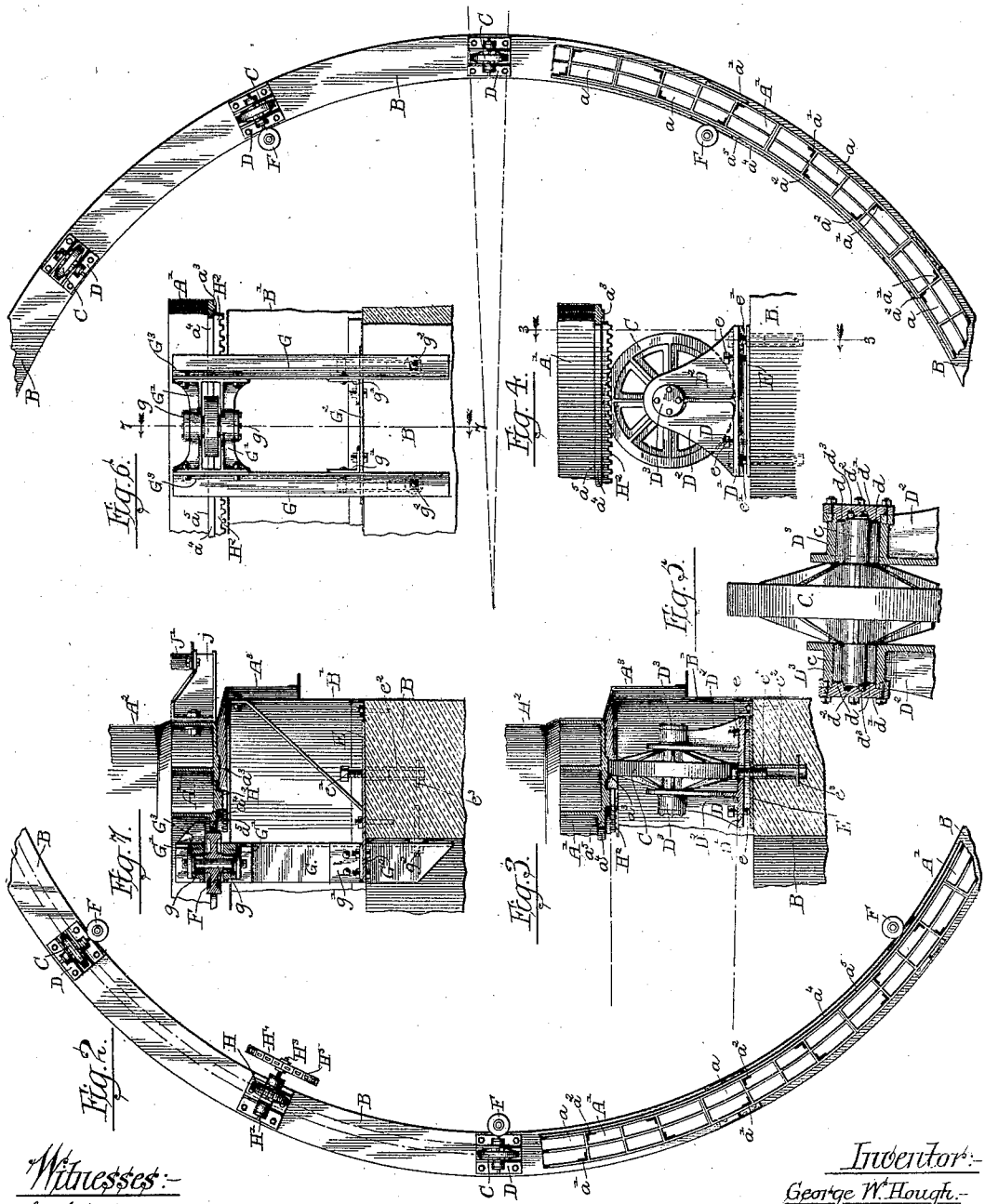
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ASTRONOMICAL DOME.

No. 416,364. Patented Dec. 3, 1889.



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(No Model.) 3 Sheets—Sheet 3.

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ASTRONOMICAL DOME.

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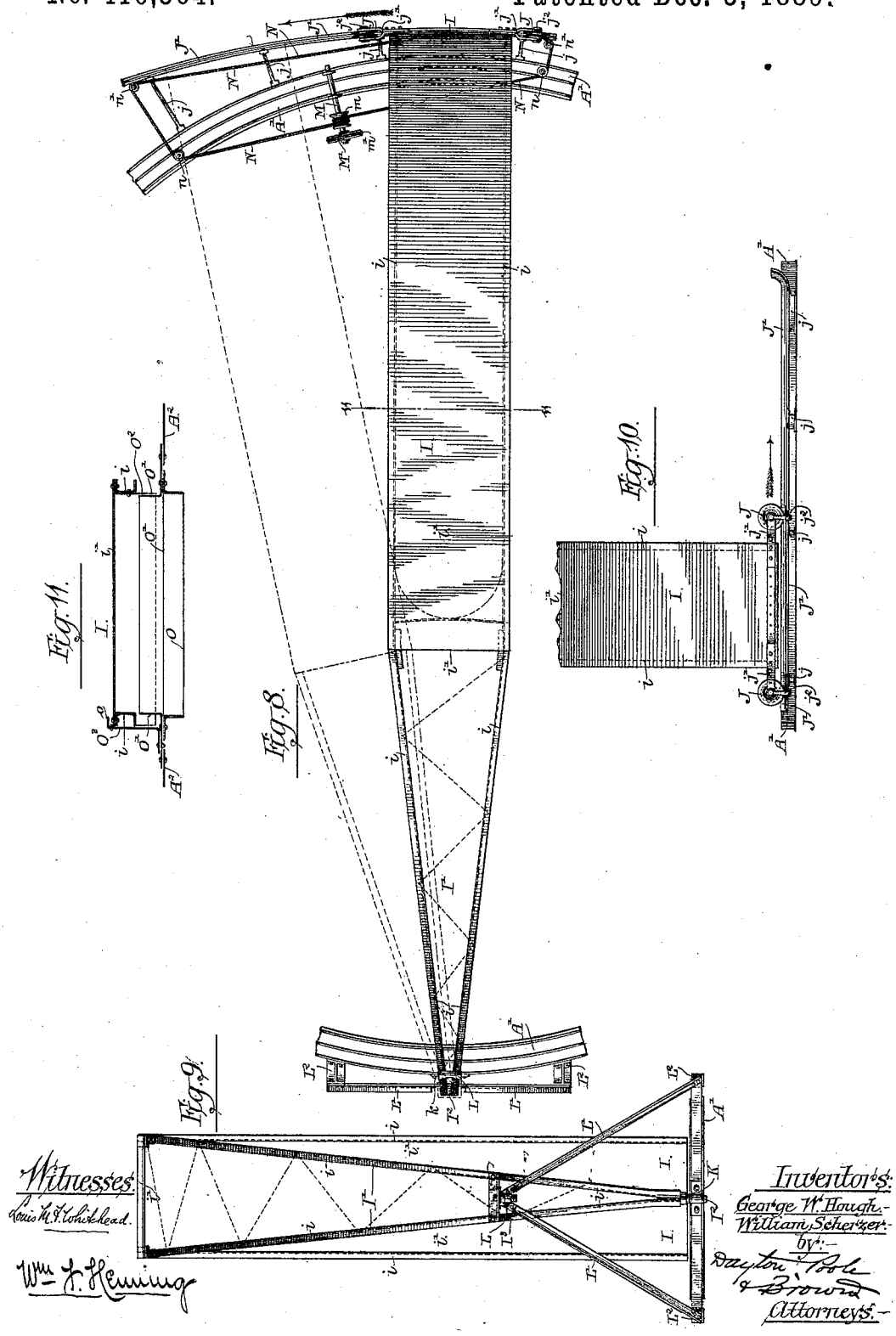


Fig. 11.

Fig. 8.

Fig. 10.

Fig. 9.

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UNITED STATES PATENT OFFICE.

GEORGE W. HOUGH, OF EVANSTON, AND WILLIAM SCHERZER, OF CHICAGO, ILLINOIS.

ASTRONOMICAL DOME.

SPECIFICATION forming part of Letters Patent No. 416,364, dated December 3, 1889.

Application filed August 13, 1889. Serial No. 320,635. (No model.)

To all whom it may concern:

Be it known that we, GEORGE W. HOUGH, of Evanston, Cook county, Illinois, and WILLIAM SCHERZER, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Astronomical Domes; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in revolving domes for observatories and similar structures, having reference more especially to means for sustaining the weight of the dome, adapted to enable the same to be turned or rotated easily or by the application of little power; to features of construction in the movable shutter or device for closing the opening or slot in the dome through which observations are made; to improvements in devices for actuating the dome, and to other features of such structures, as will hereinafter fully appear.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating our invention, Figure 1 is a side elevation of the dome and shutter, the lower portion of the dome, together with its supporting-wall, being shown in central vertical section. Fig. 2 is a sectional plan view of said parts, taken on the indirect line 2 2 of Fig. 1, so as to show the bottom ring of the dome in one half of the view and the top of the supporting-wall and the supporting wheels or rollers in the other half of the same. Fig. 3 is a detail section taken on line 3 3 of Fig. 4 through the base-ring of the dome and the top of the supporting-wall, showing one of the supporting-wheels in side elevation with its supporting-frame partially in section. Fig. 4 is a side elevation of the parts shown in Fig. 3, as viewed from the inside of the dome. Fig. 5 is an enlarged detail section through the bearings of one of the supporting-wheels, showing the details of construction thereof. Fig. 6 is a side elevation, as viewed from the inside of the dome, of one of the horizontal guide-wheels by which the dome is held from shifting on its seat. Fig. 7 is a vertical section of the same, taken upon line 7 7 of Fig. 6. Fig. 8 is a plan view of the shutter and parts supporting the same. Fig. 9 is a rear elevation thereof. Fig. 10 is an elevation showing the supporting-track for the free end of the shutter and parts adjacent to the same. Fig. 11 is a cross-section through the shutter and adjacent parts of the dome when the shutter is closed, taken upon line 11 11 of Fig. 8.

As illustrated in the said drawings, A indicates the dome as a whole, said dome consisting of a hollow metal shell, which is preferably made hemispherical in shape.

B indicates the supporting-wall of the dome, which is circular, as seen in plan view, and of approximately the same diameter as the lower part of the dome, which rests thereon.

A dome for use in connection with the main features of construction constituting our invention may be constructed in its details in any well-known or preferred manner. As herein shown, the dome is made as follows:

A′ is a horizontally-arranged base-ring, which forms the main supporting part or frame-piece of the dome proper. Said base-ring is formed of a plurality of cast segments *a a*, which are rigidly secured together, end to end, preferably by bolts, the ring being made of considerable width horizontally and having an approximately-flat bottom surface and strengthening ribs or flanges on its upper surface, arranged as clearly shown in Figs. 2 and 3. The frame of the upper part of the dome consists of a plurality of curved radially-arranged ribs *a′ a′*, over which is placed and secured an external covering or layer of sheet metal A^2. The frame-ribs *a′ a′* are secured to the outer flange of the base-ring A′, and a set of additional vertical ribs a^2 a^2 are secured to the inner flange of said base-ring and extend upward, and are secured at their upper ends to the main ribs *a′*, thereby acting as braces to give additional rigidity to the dome structure. The weight of the dome is sustained by a plurality of bearing wheels or rollers C C C, which are mounted in stationary bearings on the top of the wall B, with

their axes of rotation arranged radially with reference to the center of motion of the dome, and which are adapted to bear against the under surface of the base-ring A′ of the dome. To afford a smooth and accurate bearing-surface for the said rollers, said bearing-ring, as clearly shown in Fig. 3, is provided on its under surface with a broad or flat rib a^3, which is finished on its under surface by planing or otherwise.

Each of the several bearing-wheels C is sustained in a supporting-frame D, having bearings for the wheels and constructed as follows: D′ is the base-plate of the supporting-frame, which is provided with two upwardly-extending arms D^2 D^2, located inside of and outside of the bearing-wheel and provided at their upper ends with bearings D^3 D^3 for the journals *c c*, Fig. 5, of the said bearing-wheels. The bearings D^3 may contain any well-known or desired form of anti-friction device to insure the easy rotation of the bearing-wheels. As herein shown, said bearings D^3 are provided with internal cylindric bearing-surfaces considerably larger than the journals *c c*, and between said journals and the said bearing-surfaces are placed cylindric anti-friction rollers *d d*, while to take the end thrust of the journals the boxes are provided with caps *d′*, within which are formed annular grooves d^2, containing one or more balls or rollers d^3, which bear against the ends of the journals and roll around in said grooves as the journals revolve. For the main purposes of our invention, however, that form of anti-friction roller-bearing containing spheres or balls may be used, or any other form of anti-friction device may be employed in place of that shown.

The supporting-frames for the bearing-wheels C, consisting of the base-plate D and arms D′, instead of being affixed immovably to the supporting-wall B, are adjustably sustained thereon in such manner that the said supporting-frames and the bearing-wheels may be moved vertically as well as shifted in their angular position. The vertical adjustment of said supporting-frames with reference to the supporting-wall is to enable the bearing-wheels to be adjusted accurately to the same horizontal plane; or, in other words, to enable said wheels to be adjusted so that they will carry equally the weight of the dome, notwithstanding any changes which may occur by the wearing of the parts or from other causes. The shifting of the angular position of the said supporting-frames and bearing-wheels is desirable in order that the peripheral surfaces of said bearing-rollers (which are made slightly conical, as indicated by the dotted lines in Figs. 2 and 3) may be brought to bear accurately on the base-ring A′ of the dome.

Any one of a great number of well-known devices may be employed for securing the vertical adjustment of the said supporting-frames or the roller bearings; but we have herein shown a form of adjusting device for this purpose which we have found to be advantageous in practice, and which forms part of our invention. Such adjusting device is made as follows: E is a bearing-plate placed upon the top of the supporting-wall B, beneath the bottom plate D′ of the supporting-frame D, and *e e* are set-screws inserted through the plate D′ and bearing at their lower ends against the said plate E beneath it. Said set-screws serve to sustain the weight of the supporting-frames and bearing-wheels, together with the dome resting thereon, and by turning the same up or down said supporting-frames may be raised and lowered, either at their inner or outer parts, or both, as may be found necessary or desirable in adjnsting the vertical and angular position of the wheels.

We have herein shown each supporting-frame as provided with four set-screws *e e e e*, two at the inner and two at the outer part thereof; but similarly-acting set-screws may be otherwise disposed, as found convenient or desirable.

For holding or clamping the supporting-frames rigidly in place after they have been vertically adjusted by the use of the set-screws *e e*, other bolts *e′ e′* are employed, which are preferably arranged in alignment with the bearing-face of the wheel, pass through the plates D′ and E, and engage nuts secured in the supporting-wall, said bolts being provided with heads which bear against the said plate D in the manner illustrated in Fig. 3. By turning said bolts *e′ e′* down against the plate D, after the position of the bearing-wheels has been properly adjusted by means of the set-screws *e e*, the bearing-wheels will be held rigidly from horizontal or other movement.

For convenience in construction of the parts, each nut e^2 consists of a tube embedded vertically in the supporting-wall and provided with an internal screw-thread to engage with the lower end of the bolt *e′*, said tube being provided at its lower part with a transverse pin or cross-piece e^3, which prevents the tube being drawn upwardly out of the wall.

Means for holding the dome centrally in position are provided, as follows: F F F indicate a plurality of horizontally-arranged guide-rollers, which are supported from the retaining-wall inside of the base-ring A′ of the dome and which bear against an annular bearing-surface a^4, formed on said base-ring. Said bearing-rollers are mounted in brackets G G, which are attached at their lower ends to the supporting-wall B and extend upwardly to a point opposite the said base-ring A′, said brackets G G being provided with connecting-pieces or cross-girts G′ G′, located above and below the said bearing-roller F and having bearing-boxes *g g* for the journals of said roller. Said bearing-boxes are preferably provided with anti-friction rollers

arranged in the same manner as the corresponding parts shown in Fig. 5 and hereinbefore described. The brackets G G are herein shown as arranged vertically and as attached to the wall by means of a horizontal plate G^2, which is bolted to the top of the wall and extends inwardly beyond the same, and to which said brackets G G are connected by means of angle-pieces g' g', said brackets being afforded a strong and rigid connection with the wall by being secured to the face of the wall at a point considerably below said plate by means of bolts g^2 g^2, inserted through the lower parts of the brackets and into the wall. As a separate and further improvement, said base-ring A′ is provided with an inwardly-extending flange a^5, upon which the bearing-surface a^4 is formed, and the brackets G G are provided with overhanging arms or projections G^3 G^3 which extend over said flange a^5, preferably without touching the same, and act as a safety device to prevent the possibility of the dome being lifted from the bearing-wheels by strong winds.

Devices for turning the dome by hand are provided, as follows: H is a gear-wheel located between two of the supporting-wheels C C, and mounted in a supporting-frame H′, constructed in the same manner as the supporting-frames D of the bearing-wheels. Said gear-wheel is adapted to engage a curved rack H^2, attached to or formed upon the lower surface of the base-ring A′, as clearly shown in Figs. 3 and 4. Said gear-wheel H is mounted upon a shaft H^3, which extends through the journal-bearing inwardly past the inner face of the supporting-wall B and is provided with a sprocket-wheel H^4. Around said sprocket-wheel H^4 is placed an endless chain H^5, which passes over a chain-pulley H^6, about one-third the size of the upper one, and located at a point near the floor of the apartment covered by the dome. By means of a crank on the pulley H^6 the wheel H^4 and gear-wheel H may be easily turned, as desired, thereby enabling the dome to be rotated to bring the slot or opening therein to any desired point.

For the purpose of making a close joint between the lower edge of the dome and the top of the supporting-wall B the following construction is employed: B′ is an annular metal flange or plate attached to the said wall B outside of the bearing-wheels and extending upwardly therefrom to a point near the lower edge of the dome. A^3 is a similar metal flange attached to the outer part of the base-ring A′ and extending downwardly outside of and overlapping the said flange B′. In the particular construction herein shown, Fig. 3, the flange B′ is arranged flush with the outer surface of the supporting-wall, and inasmuch as the outer margin of the base-ring is smaller in diameter than the said flange B′ the flange A^3 is therefore extended outward over the top of the said flange B′ and then downward, in the manner illustrated.

In observatory-domes as heretofore constructed the dome itself has commonly been provided with a deep depending flange or apron extending downwardly, so as to surround and protect the anti-friction wheels or rollers which support the dome. Such deep flange adds much to the weight of the dome and increases, therefore, the difficulty of turning it, a result which is avoided in the construction herein illustrated, for the reason that the weight of the flange B′, which forms the main part of the wall surrounding the supporting-wheels, is carried by the wall, and the dome is required to support only the weight of the relatively narrow and light flange A^3, which overlaps the top of the same.

I indicates a swinging shutter by which the slot or opening in the top of the dome is closed to exclude the weather, and which is adapted to be shifted to one side of said slot for opening the latter at the time of making observations. Said shutter consists of a suitable sheeting or covering applied to a frame I′, which extends entirely over the dome and is mounted at its end remote from the opening or slot on a vertical pivot located near the base of the dome, while at its opposite end, or that nearest the slot, it is provided with wheels or rollers J J, which rest upon a horizontal track J′, and thereby sustains the weight of the free or movable end of the shutter. The said frame I′ of the shutter is herein shown as consisting of two bars i i, which are parallel throughout the length of the shutter proper, or that part which comes opposite or over the slot in the dome, and are converged or brought together from the upper end of said shutter proper to the point at which they are pivotally connected with the dome. The space between said frame-bars opposite the slot or opening is covered by a strip or layer i' of sheet metal, Figs. 8 and 11, while that part of the frame between the upper end of the slot or opening and the pivot of the frame consists simply of an open frame-work consisting of the frame-pieces i' i' and suitable cross-bracing, as illustrated in the drawings.

The pivotal support for the shutter constitutes an important part of our invention, and is made as follows: I^2 is a journal bearing or pivot arranged vertically and attached to the lower end or point of the shutter-frame I′. Said journal bearing or pivot is mounted in a bearing K, which is secured to the base-ring A′ of the dome, Figs. 1, 8, and 9. Said bearing K, in the particular construction illustrated, is sustained at some distance from the base-ring by means of a bracket k, bolted to the said base-ring in the manner illustrated. I^3 is another vertical journal bearing or pivot attached to the shutter-frame I′, above and in alignment with the journal-bearing I^2. Said journal or pivot I^3 is engaged with a bearing L, which is rigidly sustained from the frame of the dome by means of suitable arms or brackets, (herein shown as consisting of two inclined braces L′ L′,) which are secured at

their upper ends to said bearing and are attached at their lower ends to the base-ring A′ conveniently by means of brackets L^2, bolted to said base-ring in the manner illustrated, Fig. 8. The two bearings K and L, arranged at a considerable distance vertically one from the other in the manner shown, hold the shutter in an upright position while allowing the free end of the same to be easily moved or shifted. The employment of two bearings, furthermore, insures steadiness in the shutter when the same is subjected to high winds or storms.

The track J′ for the supporting-rollers J J at the free or swinging end of the shutter is sustained from the dome, preferably by means of brackets *j j*, extending outwardly from the base-ring of the dome, said track being curved or bent to a circle the center of which is coincident with the vertical pivot of the shutter. The wheels or rollers J J which run upon said track are conveniently mounted in brackets *j′ j′*, which are secured to and extend outwardly from the sides of the shutter I, Fig. 10. To prevent possibility of the shutter being lifted by strong winds, safety-clips j^2 j^2 are permanently secured to the brackets *j′ j′*, and extend partially around the track J′ in such manner that they will come in contact with the track and arrest the upward movement of the shutter in case the same is lifted by the force of the wind from its normal position.

Devices by which the shutter may be moved or shifted from the inside of the building are shown in Fig. 8, and constructed as follows: M is a horizontal shaft mounted radially in the lower part of the dome, adjacent to the lower end of the shutter I. Said shaft is provided with a spool or windlass *m* and with a grooved pulley *m′*, on which is placed an endless band or rope *m′*. N N are two ropes or cables which are both wrapped around the spool *m* and, passing around two guide-pulleys *n n* on the lower part of the dome, and two other pulleys *n′ n′* on the track J′, are secured at their ends to the lower part of the shutter I. When the shaft M and the windlass are turned by the use of the rope *m′*, the cable N will be wound upon the windlass at one end and unwound from the same at its other end, thereby drawing the shutter laterally in either direction, according to the direction in which the shaft is turned. The shaft and other parts being mounted on the dome turn with the same, when the dome is rotated, the rope *m′*, which hangs down within the supporting-wall, being at all times within the reach of the operator on the floor of the observing-room, while being free to move or swing around with the dome.

In Fig. 11, which illustrates the construction of the shutter and adjacent part of the dome, O is an angle-iron which extends around the opening or slot of the dome, and is bolted to the outer covering A^2 thereof, and which extends inwardly or downwardly and is attached to the radial frame-ribs where the latter intersect the same. O′ is an outwardly-extending flange extending around the said slot or opening and upwardly or outwardly therefrom, to protect the hole or slot from the entrance of water running down or over the roof. The longitudinal frame-pieces *i i* of the shutter are located outside of or above the flange O′, so that one of said frame-pieces will pass over said flange in closing and opening the shutter. One of said frame-pieces is provided with a downwardly or inwardly extending metal strip or flange O^2, which reaches nearly to the covering A^2 of the dome in such manner as to come against or overlap the flange O^2 when the shutter is closed. Any such flange is absent on the opposite or rear side of the shutter in order that the frame-piece *i′* may pass freely over the said flange O′. O^3 is a metal strip or flange located at the side of the opening or slot of the dome toward which the shutter moves in closing the same, the flange being provided with a laterally-bent part or flange *o* parallel with the surface of the dome, within or under which the edge of the shutter passes when the same is closed. The overlapping flanges on the dome and shutter serve to effectually exclude rain from the slot.

Observatory-domes as commonly constructed are arranged to rest on a plurality of traveling rollers, which move on tracks or ways on both the supporting-wall and dome and have bearings in a "live" or moving ring, or in a series of connected trucks. In a supporting device thus constructed the rolling friction arising from the use of two sets of tracks, combined with the friction due to the turning of the rollers in their bearings, produces an amount of resistance which renders a dome thus sustained much more difficult to turn than one made as herein shown.

The use of stationary bearing-wheels provided with anti-friction bearings and acting on an annular bearing surface or way on the dome is, as far as we know, novel, and a construction embracing these features is herein claimed as part of our invention.

We claim as our invention—

1. The combination, with a circular supporting-wall, of a revolving dome provided with a horizontal annular bearing-surface at its lower edge, and a plurality of supporting-wheels mounted in stationary and vertically adjustable bearings upon said wall and engaging the said annular bearing-surface of the dome, substantially as described.

2. The combination, with a circular supporting-wall, of a revolving dome provided with a horizontal annular bearing-surface at its lower edge, a plurality of supporting-wheels engaging the said annular bearing-surface of the dome, and supporting-frames for the said wheels provided with bearings for the wheels and having vertically-adjustable attachment to the said supporting-wall, substantially as described.

3. The combination, with a circular sup-

porting-wall, of a revolving dome provided with a horizontal annular bearing-surface at its lower edge, a plurality of supporting-wheels engaging the said annular bearing-surface of the dome, and supporting-frames for the said wheels provided with bearings for the wheels, said supporting-frames being supported upon the wall by means affording both vertical and angular adjustment of the same, substantially as described.

4. The combination, with a circular supporting-wall, of a revolving dome provided with a horizontal annular bearing-surface at its lower edge, a plurality of supporting-wheels engaging the said annular bearing-surface of the dome, and supporting-frames for the said wheels provided with bearings for the wheels and having vertically-adjustable attachment to the said supporting-wall, and means for adjustably sustaining the said frames upon the wall, comprising set-screws inserted through the frame and bearing against the wall, and bolts engaging the said frame and the wall, substantially as described.

5. The combination, with a circular supporting-wall, of a revolving dome provided with a horizontal annular bearing-surface at its lower edge and an inner annular bearing-surface, of a plurality of supporting-wheels mounted in stationary bearings upon the said wall and engaging the horizontal annular bearing-surface of the dome, and a plurality of guide-rollers mounted upon the wall and engaging the said inner bearing-surface, substantially as described.

6. The combination, with a dome provided with a slot or opening in its top, of a shutter having a frame reaching from one side of the dome to the other over the top of the same, two pivots arranged vertically in alignment with each other at some distance apart and connecting one end of said shutter-frame with the dome, and a supporting-track at the opposite end of the shutter-frame, substantially as described.

7. The combination, with a dome provided with a slot or opening and an external shutter therefor, provided with a frame extending from side to side of the dome, said frame being provided with two vertically-arranged pivots located one above the other, a bearing for the lowermost pivot located near the lower edge of the dome, and a bearing for the uppermost pivot sustained from the dome by braces or brackets, substantially as described.

8. The combination, with a dome provided with a slot or opening and an external shutter therefor, provided with a frame extending from side to side of the dome, said frame being pivoted at one end to the dome, a track sustaining the opposite end of the shutter, and means for actuating the shutter, comprising a rope or cable attached to opposite sides of the shutter, guide-pulleys therefor, and a windlass about which both ends of said cable are wound, substantially as described.

9. The combination, with a dome provided with a slot or opening, and an external shutter therefor, provided with a frame extending from side to side of the dome, said frame being pivoted at one end to the dome, a track sustaining the opposite end of the shutter, and means for actuating the shutter, comprising a rope or cable attached to opposite sides of the shutter, guide-pulleys therefor, a windlass about which both ends of said cable are wound, a rope-pulley attached to the windlass, and a rope passing over the pulley for turning the same, substantially as described.

In testimony that we claim the foregoing as our invention we affix our signatures in presence of two witnesses.

GEORGE W. HOUGH.
WILLIAM SCHERZER.

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C. CLARENCE POOLE,
HARRY COBB KENNEDY.