No. 670,614. Patented Mar. 26, 1901.

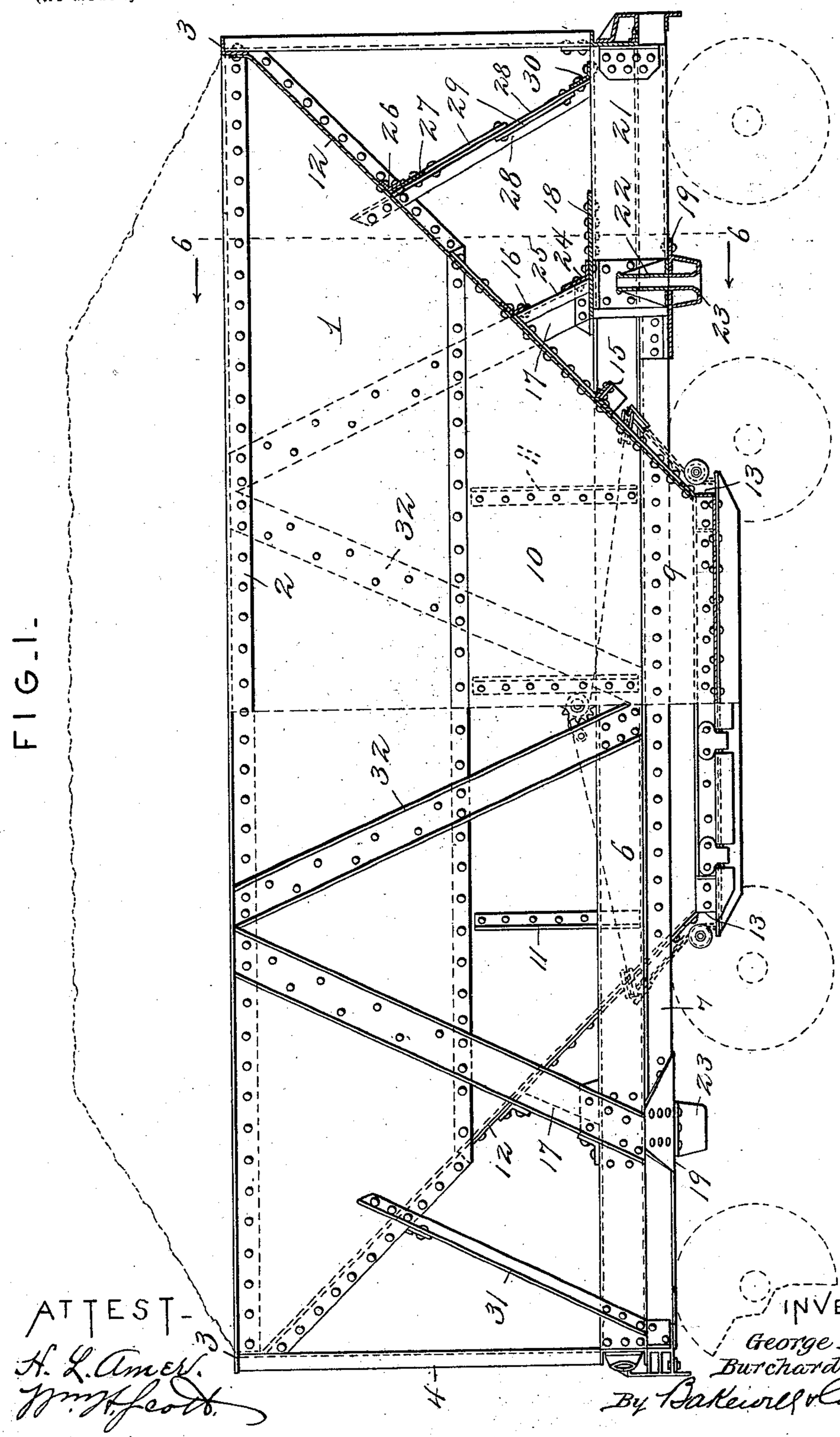
G. I. KING & B. H. JESSEN.

HOPPER BOTTOM CAR.

(Application filed Jan. 7, 1901.)

(No Model.) 5 Sheets—Sheet 1.

FIG. 1.



ATTEST-
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Attys

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(No Model.) 5 Sheets—Sheet 2.

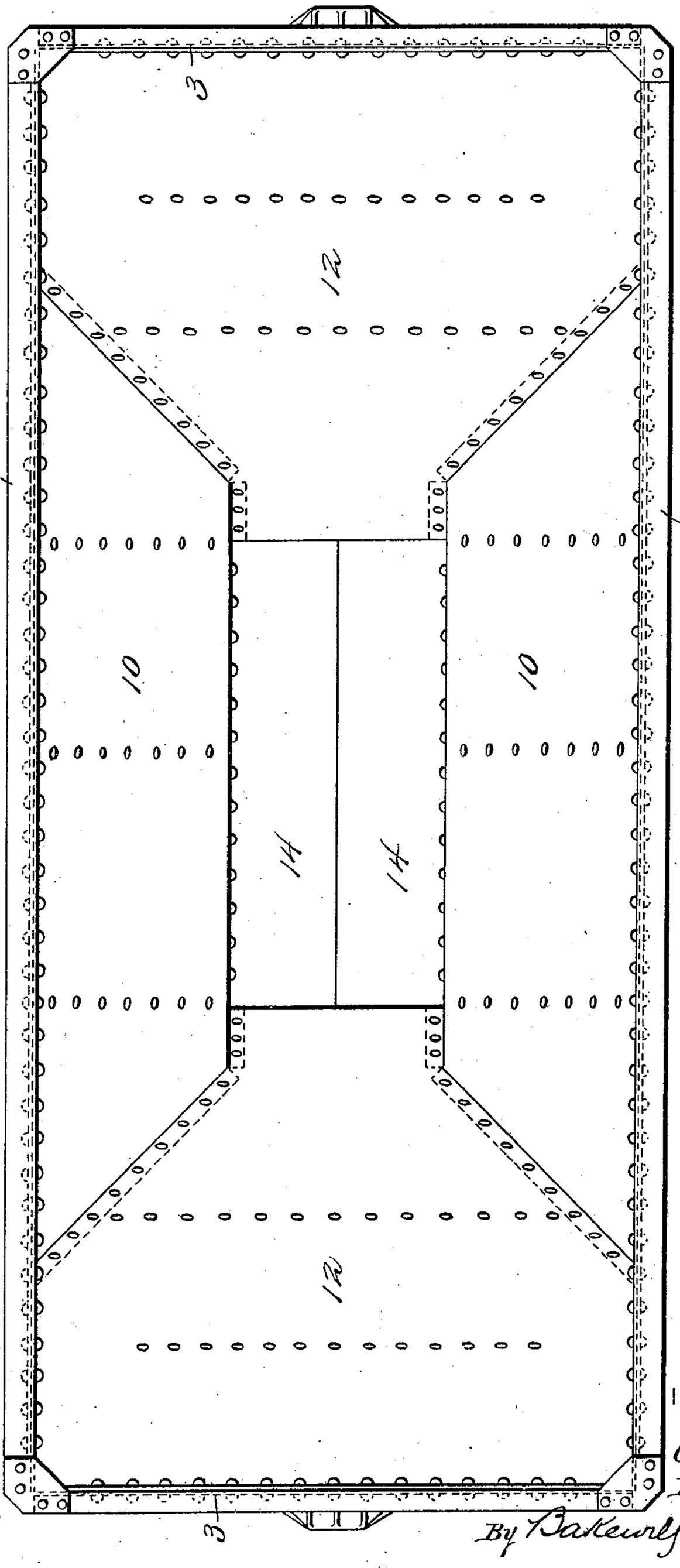

FIG. 2.

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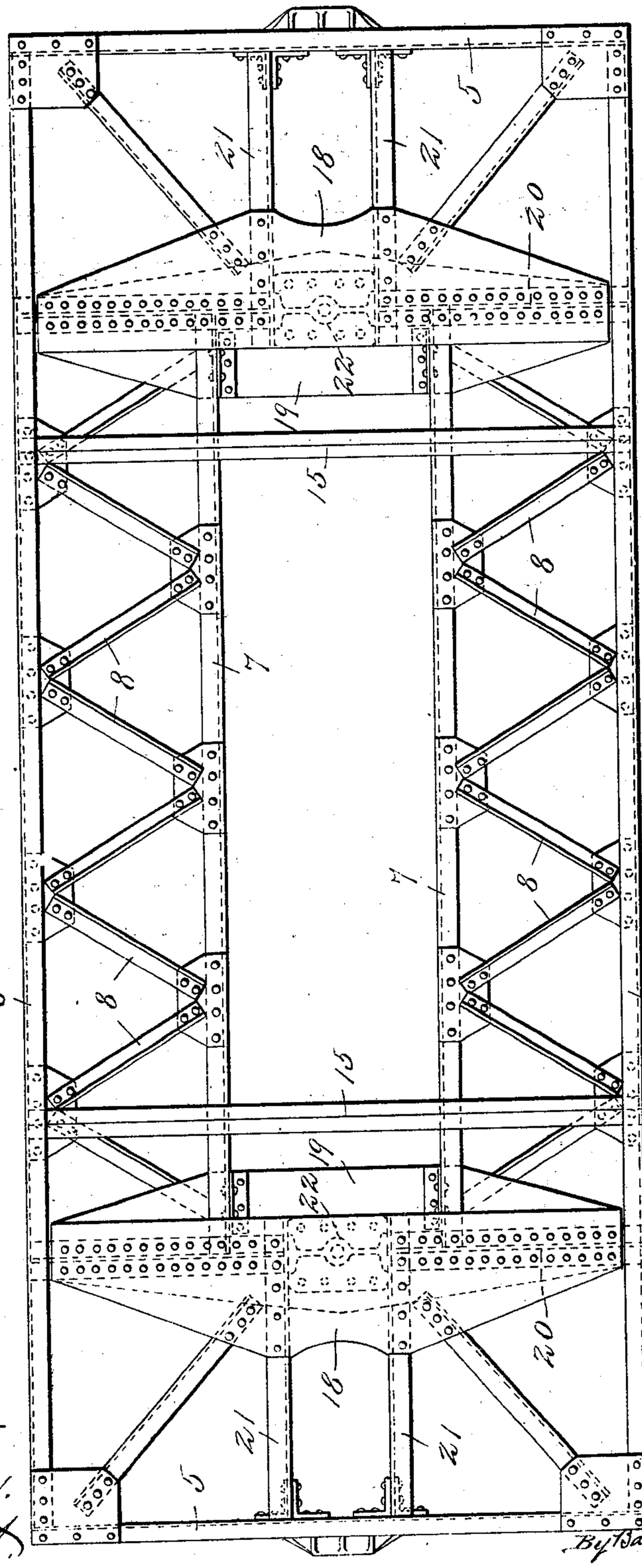
(No. Model.) 5 Sheets—Sheet 3.

FIG. 3.



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(No Model.) 5 Sheets—Sheet 4.

FIG. 5.

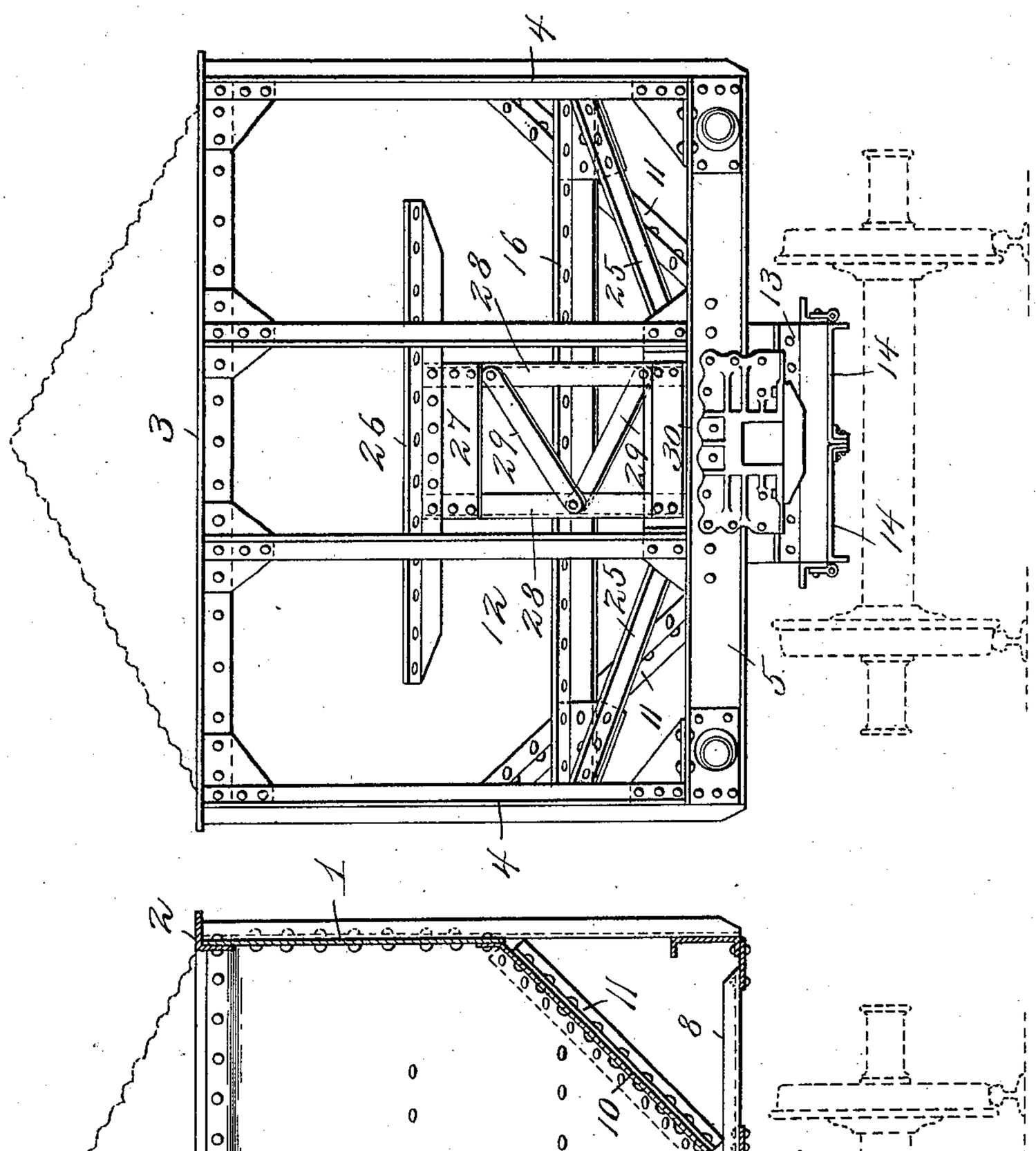
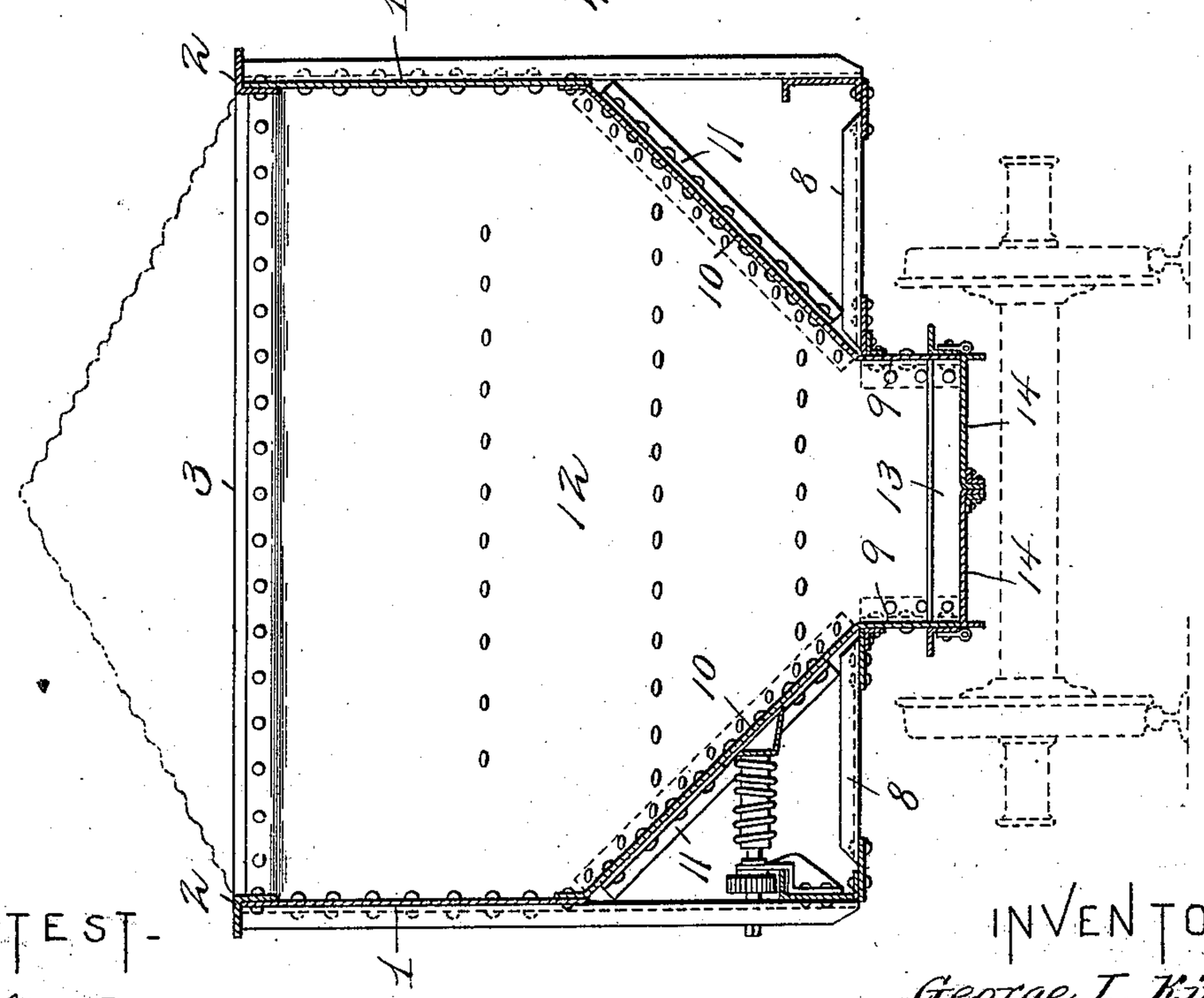


FIG. 4.



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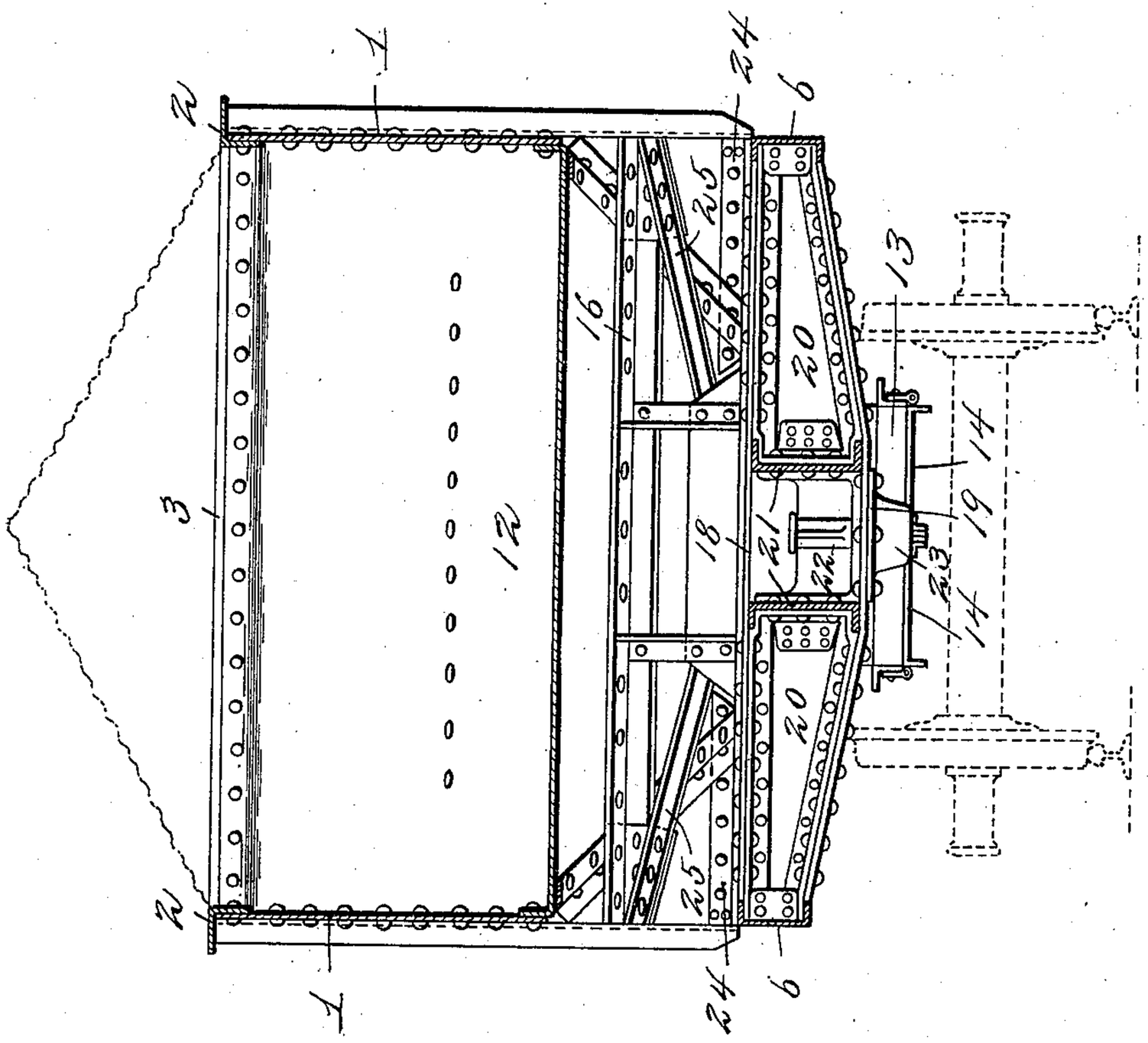
(Application filed Jan. 7, 1901.)

(No Model.) 5 Sheets—Sheet 5.

FIG. 6.



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UNITED STATES PATENT OFFICE.

GEORGE I. KING AND BURCHARD H. JESSEN, OF DETROIT, MICHIGAN, ASSIGNORS TO THE AMERICAN CAR & FOUNDRY COMPANY, OF ST. LOUIS, MISSOURI.

HOPPER-BOTTOM CAR.

SPECIFICATION forming part of Letters Patent No. 670,614, dated March 26, 1901.

Application filed January 7, 1901. Serial No. 42,371. (No model.)

To all whom it may concern:

Be it known that we, GEORGE I. KING, a citizen of the United States, and BURCHARD H. JESSEN, a subject of the King of Sweden and Norway, both residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Hopper-Bottom Cars, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevational view, partly in section, of our improved hopper-bottom car. Fig. 2 is a top plan view of the car. Fig. 3 is a plan view of the under framing, the car-body being removed. Fig. 4 is a vertical sectional view taken about the center of the car. Fig. 5 is an end elevational view; and Fig. 6 is a vertical sectional view taken on line 6 6, Fig. 1.

This invention relates to a new and useful improvement in hopper-bottom cars designed especially for carrying ore.

One object of the invention is to construct a car of the character described whose floor slope is not less than forty-five degrees with the vertical, the car having sufficient cubic capacity to handle a large quantity of ore—say about fifty tons—the weight of which ore is commonly not less than one hundred pounds per cubic foot.

Another object is to provide a large door-opening or exit for the load, so that the load may be properly discharged even in cold weather, when the contents of the car may be more or less solidly frozen. This "hopper-opening," as it is commonly called, is arranged within the line of the inner truck-wheels, requiring a special arrangement of under framing, which must be very rigid to resist both longitudinal and transverse stresses. The tendency to displace the side sills laterally, due to the pressure of the contained load, is resisted by the under framing in the form of lattice-girders lying in a horizontal plane, which girders take the places of the separate side and center sills commonly met with in cars of this type. As a consequence of the large door-opening the center sills are discontinuous, being made up of short sections at each end, extending only from bolster to end sill. The usual air-brakes, couplers, trucks, steps, ladders, hand-holes, &c., are provided, but are not shown in the accompanying drawings, because such parts are well known and understood.

The invention consists, generally stated, in making the side walls of the car of sheets or plates of metal in the form of plate-girders, which in addition to carrying their proportion of the load also serve as the containing side walls of the car and form members of a trussed structure, in connection with other members of the side framing. To resist the shearing forces at the ends of the plate-girders, we provide inclined stiffening-braces in the form of channels which slope downwardly and outwardly toward the point of support—to wit, the body-bolsters of the car—said stiffening-braces being tied together by floor-beams, which latter afford means of attachment of the floor-supports. These stiffening-braces serve as the end posts for the trussed structure and as the main supports for the superstructure above the bolster. The side sheets of the car (shown in the accompanying drawings) do not extend down to the side sills, the sloping side floor-sheets and their attached parts serving as tension-flanges for the plate-girders, said sloping side sheets also coöperating with lattice-girders, as will hereinafter be described.

The invention also consists in the construction, arrangement, and combination of the several parts, all as will hereinafter be described and afterward pointed out in the claims.

In the drawings, 1 indicates the side sheets of the car-body, which are preferably sheared to the proper shape, said sheets terminating some distance above the side sills of the car.

2 indicates an angle riveted to the upper edge of the side sheet and forming the compression-flange thereof and also forming, in conjunction with the side sheet, the top chord of the truss.

3 indicates an angle arranged at the end of the car, to which is connected the vertical end posts 4 through suitable connection-plates,

said end posts being attached at their lower ends through suitable connection-plates to the end sill 5.

6 indicates a channel secured to the end of the end sill and performing the functions of side sills and bottom chord of the truss, as well as entering into a lattice-girder construction of which the angle 7 serves as a parallel member. These members 6 and 7 carry suitable connection-plates, to which are riveted the lattice-bars 8, as shown more clearly in Fig. 3. Referring to Fig. 4, it will be noted that this angle 7 is arranged on a horizontal plane slightly beneath the bottom flanges of the channel 6 and has riveted to its vertical member the vertical portion 9 of the sloping side floor-sheet 10. The upper edge of this floor-sheet 10 is riveted to the lower edge of the side sheet 1 and is reinforced on its under side by angles 11, as shown in Figs. 1 and 4.

The inclined end sheet 12 has its upper edge riveted to the angle 3, while the upper portion of its side edges are flanged downwardly and secured to the side sheets 1. The lower portion of the end sheet is sheared to accommodate the slope of the side floor-sheets 10, which latter, as shown in Fig. 2, are flanged under the end sheets, rivets being employed to make a good connection between the sloping floor and end sheets.

The lower inner edge of the end sheet has an angle 13 secured thereto, the vertical member of which angle forms the vertical end wall of the hopper-opening.

14 indicates the hopper-doors, which are hinged, respectively, to the angles 14^a, riveted to the lower edges of the side floor-sheets, said doors opening in opposite directions, suitable operating mechanism being provided for this purpose.

15 indicates an angle extending transversely the car and supported at its ends by the channels 6, said angle serving as a floor-beam in addition to tying the channels against lateral displacement.

16 indicates a floor-beam in the form of an angle whose ends are connected either directly or through suitable connection-plates to the inclined stiffening-braces or truss end posts 17. These inclined stiffening-braces or truss-posts are in the form of channels and have their upper ends riveted to the side sheets 1, while their lower ends are riveted to the ends of the body-bolster through the channels 6. This body-bolster may be of any suitable construction, but is preferably of the type illustrated in an application filed by George I. King on or about November 23, 1900, Serial No. 37,450. This type of body-bolster contemplates top and bottom cover-plates 18 and 19, respectively, and web-plates 20, which latter extend from the channels 6 to the center sills 21, an intermediate casting 22 being arranged between the center sills for the purpose of spacing said sills and also receiving the king-bolt. The bottom cover-plate 19 is provided with the usual center bearing 23, which is preferably riveted thereto, as well as the ordinary side bearings, the latter not being shown. It will be observed that the center sills 21 are sufficiently deep to accommodate the draft-rigging, said center sills being riveted to the end sills and forming parts of the body-bolster above described, they terminating just beyond the vertical webs 20 of said body-bolsters, which webs are secured to said center sills by the use of suitable corner connection-plates. The top cover-plate 18 of the body-bolster has a reinforcing-angle 24 riveted thereto, which angle forms a point of attachment for inclined braces 25, whose upper outer ends are secured to the floor-beams 16 by the use of suitable connection-plates.

26 indicates an angle riveted to the floor above the point of attachment of the angle 16, to which angle 26 is riveted a connection-plate 27 for the attachment of inclined floor-supports 28. These floor-supports may be and preferably are strengthened by lattice-bars 29. The lower ends of these floor-supports are connected to an angle 30, riveted to the top flanges of the center sills. In the transverse planes of these floor-supports 28 are inclined posts 31, arranged at the sides of the car, as shown more clearly at the left in Fig. 1, the lower ends of these posts being riveted to the channels 6.

32 indicates channels forming a V-shaped stiffening and strengthening frame in the middle of the car and also diagonals for the trussed structure, said channels being secured to the exterior faces of the side sheets and the channels 6. The upper or divergent ends of these channels 32 are adjacent the upper ends of the inclined stiffening-braces or truss-posts 17, before referred to.

The construction above described is very strong and rigid and comparatively light considering the load it is designed to carry. While we have described the side sheets as being plate-girders designed to carry their proportion of the load, the introduction of the lattice-girders, consisting of the elements 6, 7, and 8 and the arrangement of the inclined stiffening-braces or truss end posts and the diagonals 32, renders the term "plate-girder" as applied to the side sheets rather indefinite, because such term does not include the under framing and its connections with the plate-girder sides. In other words, the side framing is made up of a trussed structure including in its composition the plate-girder side sheets, which form the upper chords of the trussed frame, while the horizontally-placed girders 6, 7, and 8 form the lower chords, being placed in tension under load and reinforced by the sloping side floor-sheets, which, with their connected parts, form the tension-flanges of the plate-girder side sheets. The function of the inclined stiffening-braces or truss end posts is not only to resist the shearing forces

at the ends of the side sheets, but also to strengthen said side sheets against lateral bulging and act as main supports for the superstructure above the bolsters. These inclined stiffening-braces or posts in serving as the main supports for the upper portion of the car-body have part of the load transmitted to them through the diagonals 32, which are used in lieu of the commonly-formed vertical members and diagonals. The arrangement of the two diagonals 32 greatly simplifies the construction and reduces the number of parts which have heretofore been commonly employed in trussed side framing in car construction.

The elements of the trussed structure shown in the drawings may be considered, as before described, as consisting of the side sheet 1, in connection with the angle 2, forming the top chord, the inclined stiffening-braces 17, forming the end posts, the channels 32, forming the intermediate diagonals, and the horizontally-disposed girder, composed of the parts 6, 7, and 8, which girder forms the bottom or tension chord of the truss. All of these members are so connected to each other that the truss as a whole will act as a rigid body to resist the longitudinal, vertical, and lateral forces acting upon it, while each member is subjected largely to direct longitudinal stresses only. In considering the action of the truss we have to deal with two classes of forces, known as "external" forces and "internal" forces. The external forces are the loads sustained by the structure and the weight of the structure, while the supporting forces (called "reactions," in this instance found at the body-bolsters) balance the loads, and thus hold the structure in position. The truss transfers the loads to the reactions, (body-bolsters,) or, in other words, the reactions counterbalance or support the loads through the medium of the truss. The loads and reactions or external forces which act upon the truss always distort it more or less from its original form, the distortion thus produced being designated as the "strain" in the truss. To this strain or distortion the members of the truss offer resistance, and this resistance to distortion is called "stress." The stresses in the various members of a truss are the internal forces which offer resistance to the external forces, or, more properly, they are forces through the medium of which the external forces balance and resist each other. They are called "internal" forces, because they are forces internal to the members of the truss. The "external" forces are so called because they are forces wholly external to the truss. The longitudinal members of a vertical truss are subjected to tensile and compressive stresses, and if the office of a member is merely to resist the tensile stresses it is only necessary that the member shall contain sufficient material to resist those stresses without much regard being paid to the form of the member. In this case the bottom chord in the form of the horizontally-arranged girder is placed in tension. Where a member is intended to resist compressive stress, the conditions are different. Such a member must not only have sufficient material to resist the direct longitudinal stress, but it must also contain sufficient material and the material must be given such a form that the member will not bend sidewise or buckle under the applied stress. In the construction shown in the drawings the side sheet 1 and the angle 2 is the compression member or top chord. The lower edge of this side sheet is attached to the sloping floor-sheet 10, and the sheet is strengthened against lateral buckling by the channel-bar members 17 and 32. In a tension member the material may be and preferably is of compact form, as that of a solid rod or bar, which in the accompanying drawings is the channel 6; but in a compression member the material should be arranged and distributed in such a manner that it will not bend easily and should be larger as regards its exterior dimensions than the tension member. It will be observed by referring to Fig. 1 that the triangle forms the primary truss element, because a triangle is a geometrical figure whose form cannot be changed without changing the length of one or more of its sides. The simplest form of a truss is a triangle, and any perfect truss must be either a triangle or an assemblage of triangles.

Referring now to the advantages of having the lattice-girders lying in a horizontal plane and assisting to form the lower chord of the trussed side framing, the sloping floor-sheet 10 is connected at its upper edge to the side sheet 1, not only strengthening said side sheet against lateral buckling, but serving, with its connections, if we consider the side sheet *per se* as a plate-girder, as a tension-flange therefor. This sloping floor-sheet has its lower edge attached to the angles 7 and 14ª, the former being a member of the lattice-girder, so that through this connection the parts mutually support each other and add to the rigidity of the entire structure. Considering then the trussed side frame as including the horizontal lattice-girder, whose ends are supported by the body-bolsters, we have a triangular formation extending practically throughout the length of the side of the car from bolster to bolster. The horizontal leg or the lattice-girder of this triangular construction is of great value in making the car rigid against lateral strains.

Referring now to Fig. 3, it will be seen that the channel 6 in addition to performing the function of a bottom chord for the trussed side framing also serves as a member for the lattice-girder and acts in the capacity of a side sill to take care of the buffing strains. The end sills, body-bolsters, and angles 15 serve to tie these channels 6 rigidly in posi-

tion, in addition to which the middle portions thereof are tied by the lattice-bars 8, whose inner ends are connected to the angles 7, said angles being supported at their ends by the body-bolsters. The center sills 21 are supported by the end sills and the body-bolsters, beyond which latter they terminate, and thus the buffing strains are communicated through the body-bolsters and the diagonal braces 33 to the angles 6 and 7, (connected by the lattice-bars 8,) the latter angle of which is reinforced by the sloping floor-sheet 10.

We are aware that minor changes in the arrangement, construction, and combination of the several parts of our device can be made and substituted for those herein shown and described without in the least departing from the nature and principle of our invention.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The combination with a side wall of a hopper-bottom car in the form of a plate-girder, of inclined stiffening bars or braces which are arranged on the side walls to better resist the shearing forces in said walls, and also prevent the plates forming said walls from buckling under action of said shearing forces, and a side sill member located some distance below said plate-girder, and to which the lower ends of said stiffening-braces are connected; substantially as described.

2. The combination with the side wall of a hopper-bottom car in the form of a plate-girder, of inclined stiffening bars or braces which are arranged on the side walls to better resist the shearing forces in said walls, and also prevent the plates forming said walls from buckling under action of said shearing forces, a side sill member located some distance below said plate-girder, and to which the lower ends of said stiffening-braces are connected, and oppositely-inclined members attached to said side wall and to said side sill member intermediate said inclined stiffening-braces; substantially as described.

3. The combination with a hopper-bottom car and its frame, the vertical side walls of said car being in the form of plate-girders, of inclined stiffening-braces arranged at the ends of said vertical walls for resisting the bulging tendency therein, said stiffening-braces sloping downwardly toward the supporting-bolsters of the frame, and oppositely-inclined members arranged along the car-body intermediate said inclined stiffening-braces; substantially as described.

4. In a hopper-bottom car, the combination with the supporting-bolsters, of a side sill member carried thereby, a vertically-disposed sheet forming the side wall of the car located some distance above the side sill member and forming the containing-wall of the car, and bars for supporting said sheet above the side sill member; substantially as described.

5. In a hopper-bottom car, the combination with the supporting-bolsters, of a side sill member, a vertically-disposed sheet forming the side wall of the car and located some distance above the side sill member, and inclined bars attached to said sheet and to said side sill member; substantially as described.

6. The combination with supporting-bolsters, of side sill members attached thereto, a vertically-disposed sheet forming the side wall of the car, inclined bars 17 secured to the side sill member opposite the ends of the bolsters and having their upper ends extend to the top of the side wall of the car, and oppositely-inclined members 32 extending from the upper ends of the bars 17, said members 32 meeting over the side sills, and abutting against each other, at about the center of the car; substantially as described.

7. The combination with the supporting-bolsters, of a trussed structure comprising side sill members which form the lower chords of said trussed structure, a vertically-disposed sheet forming the side wall of the car and forming the top chord of said trussed structure, said side wall being in the nature of a plate-girder and located some distance above the side sill, or lower chord, and inclined connections between said vertically-disposed sheet and the side sill member, which connections form triangles; substantially as described.

8. The combination with supporting-bolsters, of a side sill member attached thereto, a vertically-disposed sheet forming the side wall of the car and arranged some distance above said side sill member, triangularly-arranged supports for said side wall, and a sloping floor-sheet attached to the lower edge of said side wall; substantially as described.

9. The combination with supporting-bolsters, of a horizontally-disposed girder carried thereby, the outer member of said girder serving as a side sill, a vertically-disposed sheet forming the side wall of the car and located some distance above said side sill, triangularly-arranged supports for said side-wall sheet, and a sloping floor-sheet attached to the lower edge of the side wall and to the inner edge of said horizontally-disposed girder; substantially as described.

10. The combination with supporting-bolsters, of horizontally-disposed lattice-girders carried thereby, vertically-disposed sheets forming the side walls of the car, and located some distance above said lattice-girder, triangularly-arranged supports for said sheet which coöperate with the outer member of said lattice-girder, and a sloping floor-sheet attached to the lower edge of the side wall and to the inner member of the lattice-girder; substantially as described.

11. The combination with supporting-bolsters, of horizontally-disposed girders carried by the ends thereof, said girders comprising

the bars 6, 7 and 8, of which the bars 6 extend beyond the body-bolsters, end sills, center sills which extend inwardly to the body-bolsters, cover-plates for said body-bolsters, side sheets 1, the inclined bars 17 and 32, the sloping floor-sheets 10, and the sloping end sheets; substantially as described.

In testimony whereof we hereunto affix our signatures, in the presence of two witnesses, this 4th day of January, 1901.

GEORGE I. KING.
BURCHARD H. JESSEN.

Witnesses:
M. McHUGH,
ALBERT PANCOAST.