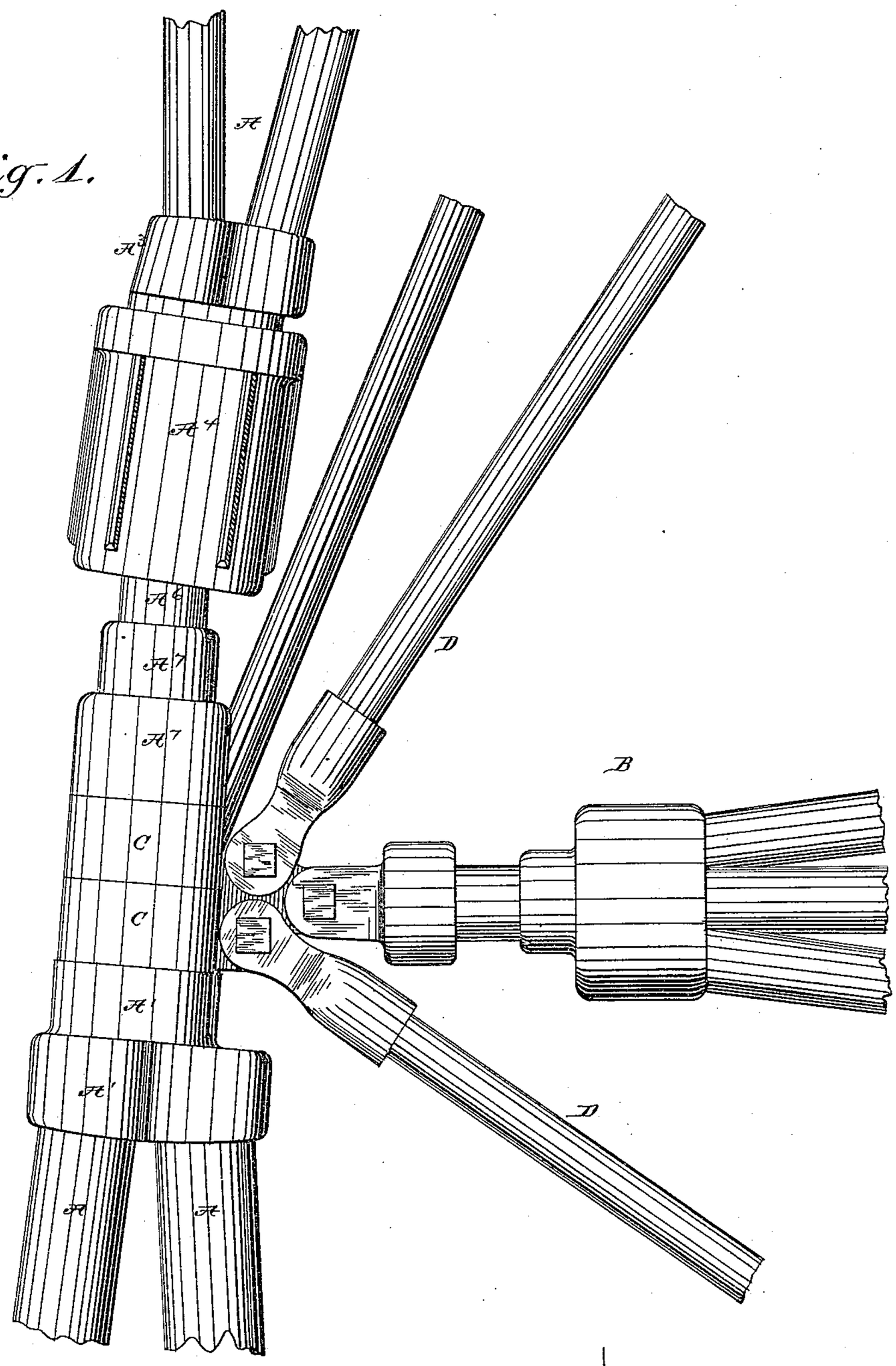
(No Model.) 4 Sheets—Sheet 1.

J. S. ADAMS.

SKELETON IRON TOWER AND MODE OF ERECTING THE SAME.

No. 297,333. Patented Apr. 22, 1884.

Fig. 1.



WITNESSES

F. L. Adams

F. W. Kaschagen.

INVENTOR

John S. Adams

per W. E. Dayton

Attorney

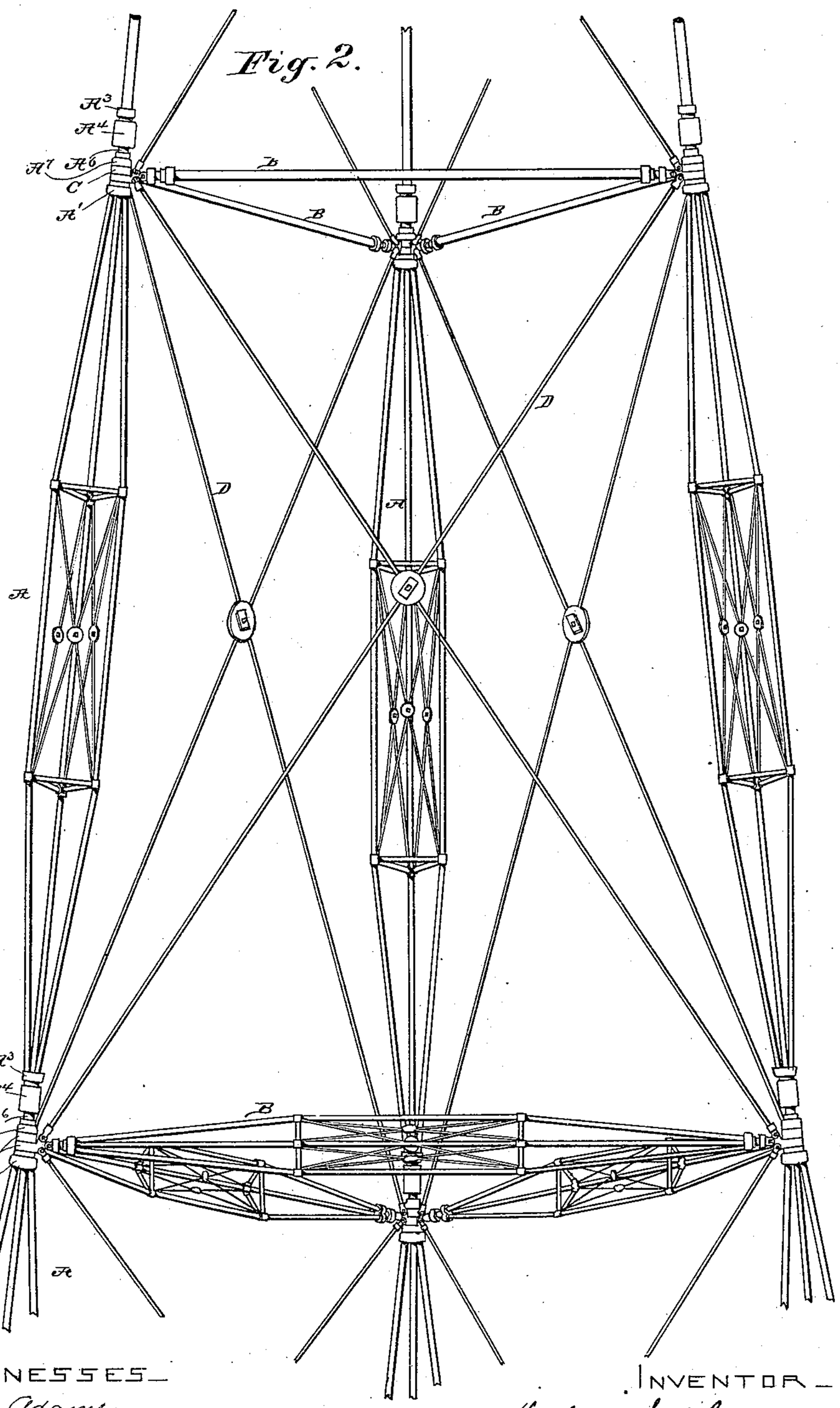
(No Model.) 4 Sheets—Sheet 2.

J. S. ADAMS.

SKELETON IRON TOWER AND MODE OF ERECTING THE SAME.

No. 297,333. Patented Apr. 22, 1884.

Fig. 2.



WITNESSES—
F. L. Adams.
F. W. Kasehagen.

INVENTOR—
John S. Adams
per W. E. Dayton
Attorney.

(No Model.) 4 Sheets—Sheet 3.

J. S. ADAMS.

SKELETON IRON TOWER AND MODE OF ERECTING THE SAME.

No. 297,333. Patented Apr. 22, 1884.

Fig. 6.

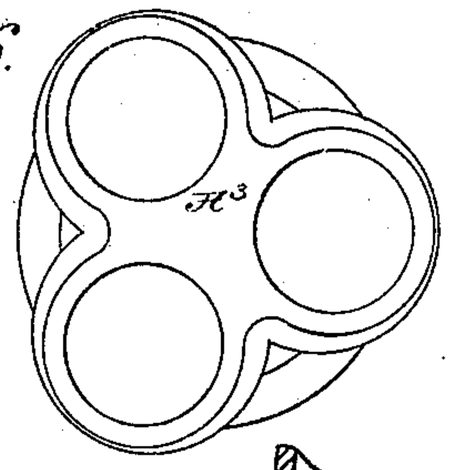


Fig. 4.

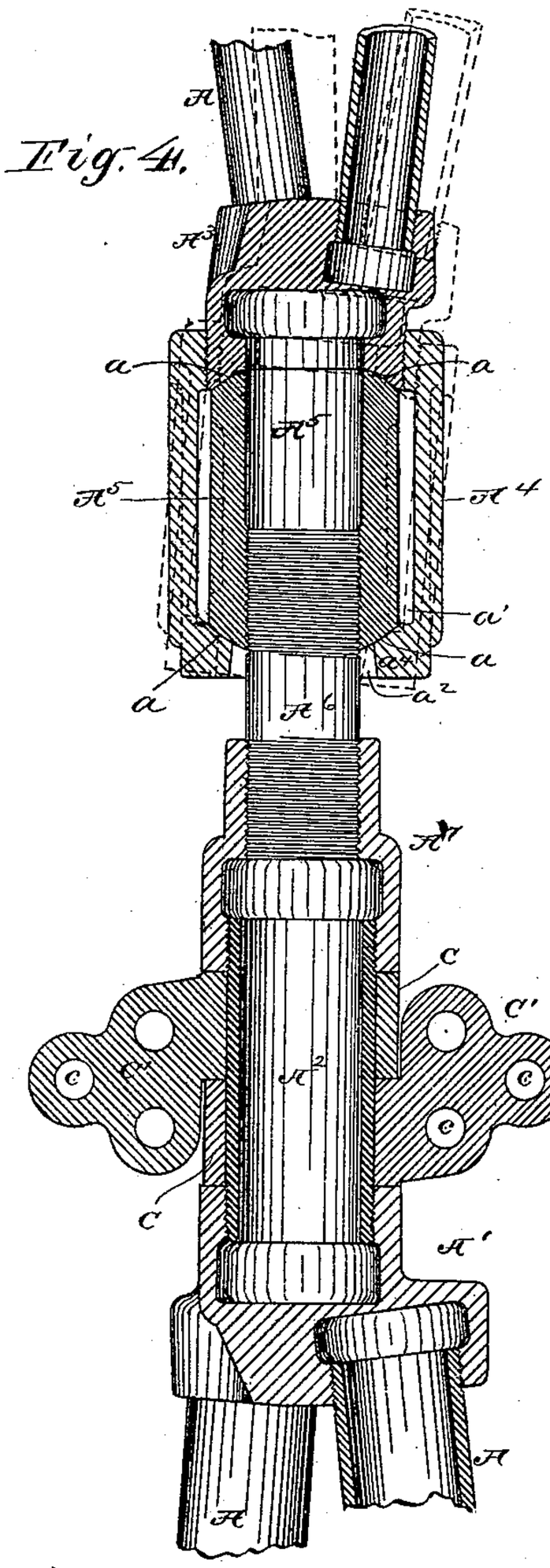


Fig. 3

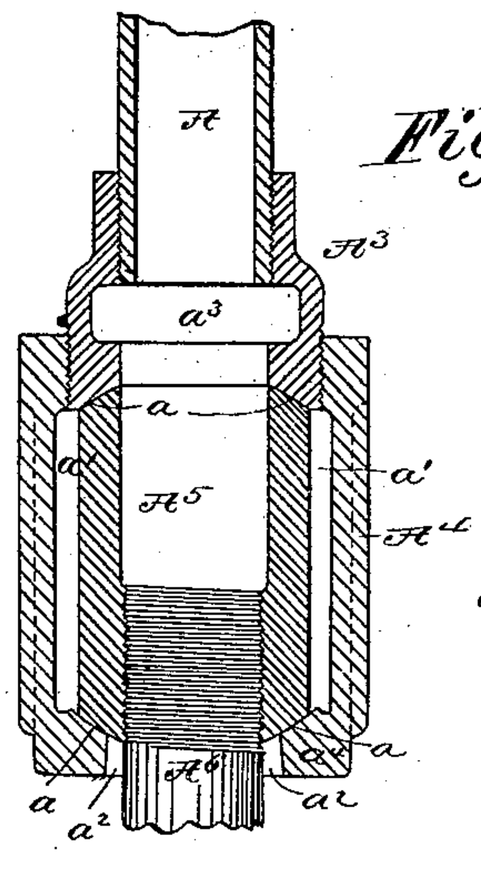
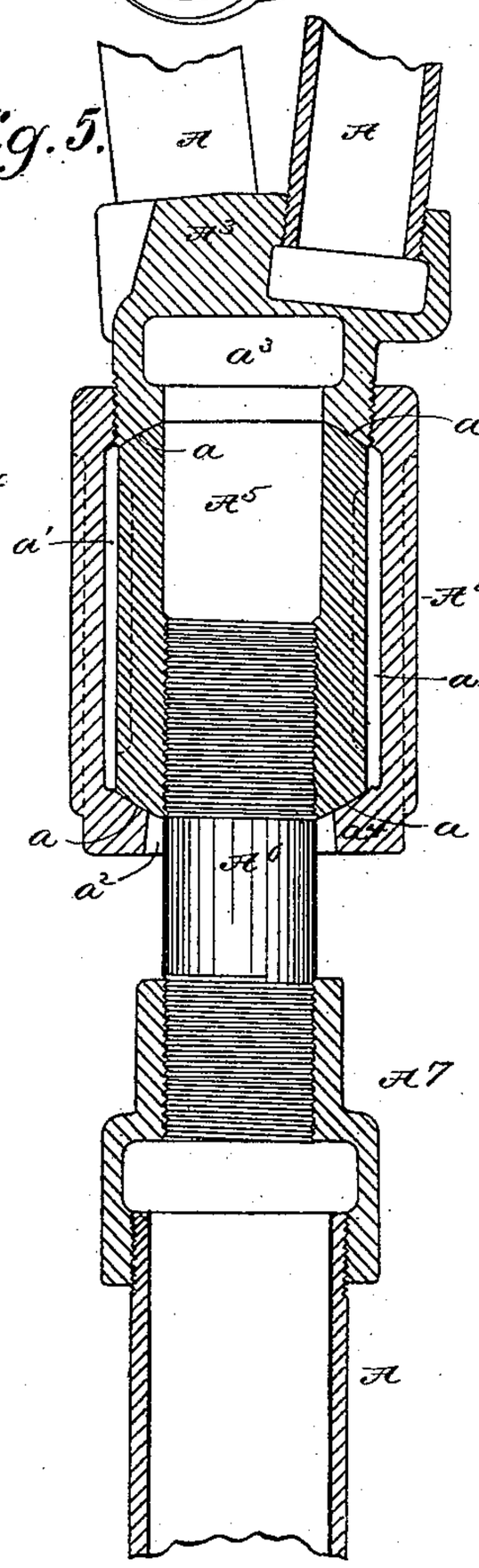


Fig. 5.



WITNESSES—
F. H. Adams
F. W. Kasehagen

INVENTOR—
John S. Adams
per W. E. Dayton
Attorney

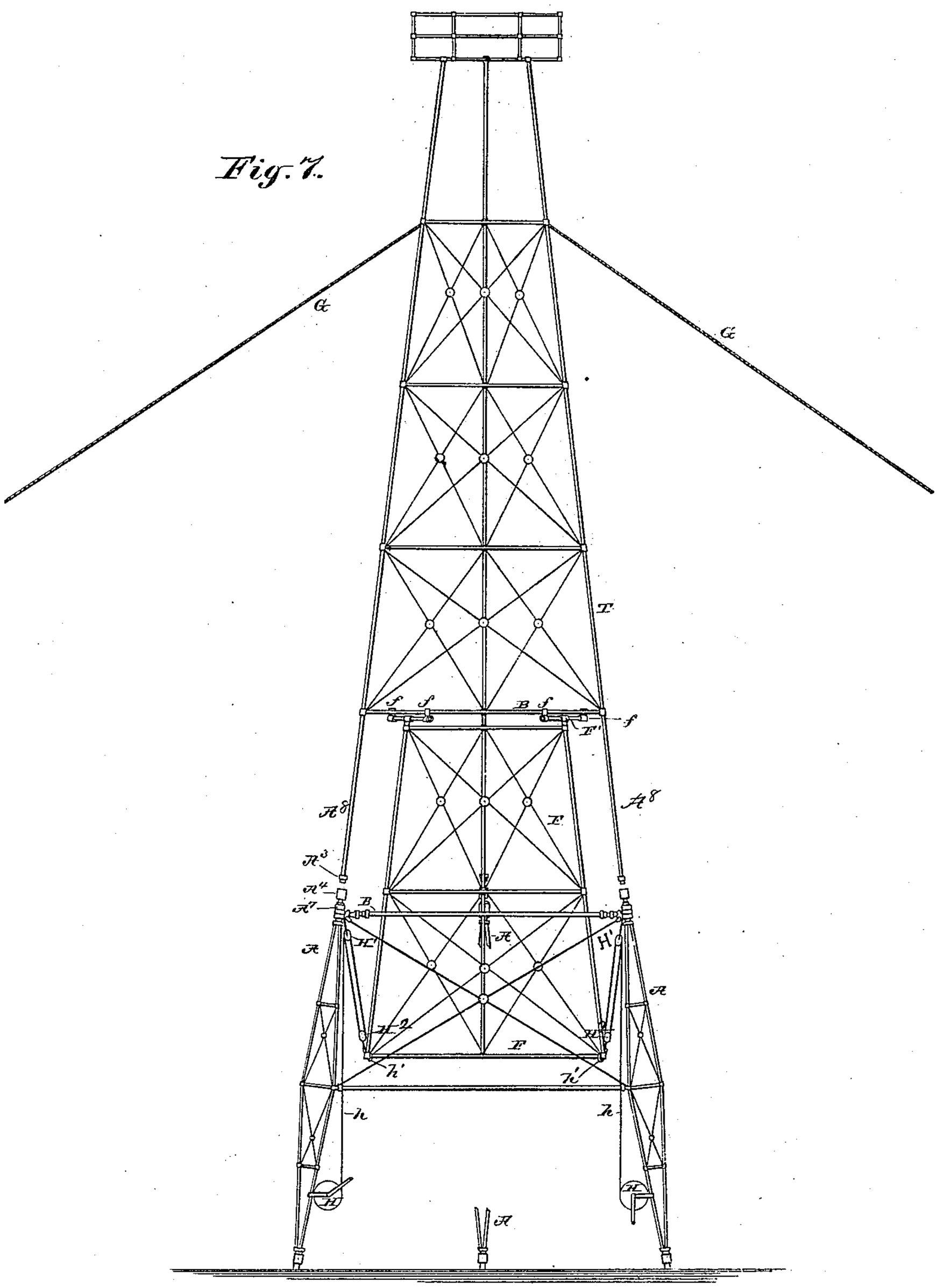
(No Model.) 4 Sheets—Sheet 4.

J. S. ADAMS.

SKELETON IRON TOWER AND MODE OF ERECTING THE SAME.

No. 297,333. Patented Apr. 22, 1884.

Fig. 7.



WITNESSES—
F. W. Adams
C. C. Poole

INVENTOR—
John S. Adams
per W. W. Dayton
Attorney

UNITED STATES PATENT OFFICE.

JOHN S. ADAMS, OF ELGIN, ILLINOIS, ASSIGNOR TO THE DETROIT IRON TOWER COMPANY, OF DETROIT, MICHIGAN.

SKELETON IRON TOWER AND MODE OF ERECTING THE SAME.

SPECIFICATION forming part of Letters Patent No. 297,333, dated April 22, 1884.

Application filed December 8, 1882. Renewed March 17, 1884. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. ADAMS, of Elgin, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Skeleton Iron Towers and Modes of Making them; and I 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.

One branch of the invention relates to an improved construction in the couplings which join adjacent sections of the uprights, and has for its object to provide a coupling that will afford a small degree of pivotal movement of the adjacent sections one with the other at their junction, sufficient to permit a more ready and easy union of the parts, and also to permit an adjustment or alignment of said parts, after they are connected, by manipulation of the diagonal braces, or otherwise, and without the weakening effects that would attend such adjustment if the coupling were rigid, as heretofore made.

Generally stated, this part of my invention consists in an application of the "ball-and-socket" form of joint to the upright sections, and in special forms of devices for this purpose that will be hereinafter fully explained.

Another branch of the invention relates to a novel method of erecting tall skeleton towers, which has for its object to facilitate and hasten the work of construction, and which consists in building a lower permanent section or sections of the tower in place and constructing the upper part of the tower within the said lower part, (raising the same and adding to the bottom thereof, section by section, if need be,) and finally hoisting the whole above the permanent point and connecting the two portions to complete the whole. The flexible coupling above referred to is found in practice to be especially useful in this method of building the tower, and particularly in making the final connection of the upper part of the tower with the base.

The invention also relates to other mechanical devices employed in this method of tower construction, in the nature of a false structure employed in raising the upper portion of the tower after its completion and preparatory to connecting it to the lower permanent section.

In the accompanying drawings, Figure 1 is a side elevation of a flexible coupling or joint, together with fragments of contiguous parts, embodying the invention claimed. Fig. 2 illustrates one entire section of a skeleton iron tower and fragments of adjacent sections, one above and the other below it, joined therewith by means of the flexible coupling referred to. Fig. 3 is a central vertical section of the flexible coupling. Fig. 4 is a similar view of said coupling and of adjacent connected parts. Fig. 5 is a similar view of said coupling and of the connected base-support which joins with the foundation-stones. Fig. 6 is a top view of the head-piece of a compound tower-section such as is shown in Figs. 4 and 5. Fig. 7 is an elevation of a tower in process of erection in accordance with the method herein set forth, and illustrating the use of the hoisting devices and the "false work" employed in such method, and also the flexible coupling elsewhere shown in detail and enlarged.

A A represent the individual uprights of the several tower-sections, said uprights being either of the compound structure shown in the completed section of Fig. 2, or of single tubes or posts, as shown in the upper fragmentary section of Fig. 2 and in the upper part of Fig. 3 and lower part of Fig. 5.

A′ represents a coupling or head piece joining the members of the compound uprights at the top.

A^2, Fig. 4, is a nipple threaded into the coupling A′, embraced by the movable eyes C, having flanges C′ for the connection of the horizontal girts B and diagonal braces D, as shown in Figs. 1 and 2.

A^7 is a coupling threaded upon the upper end of the nipple A^2, and confining the eyes C between said coupling and the lower coupling, A′.

A^6 is a solid steel nipple, having its upper end firmly threaded into a sleeve, A^5. Said sleeve A^5 forms an essential part of the flexible coupling, and has both its upper and lower ends rounded off at *a* in the surface of the sphere, whose axis is that of the sleeve.

A^4 is a shell interiorly larger in diameter than the diameter of the sleeve A^5, so as to present a space, *a*′, within said shell and exterior to said sleeve. The lower end of the shell A^4 is contracted, so as to present an in-

wardly-projecting flange, a^4, having a central aperture, a^2, somewhat larger than the nipple A^6. The upper surface of this inwardly-projecting flange a^4 is concaved to fit the adjacent end of the sleeve. At its upper end the shell is open wide enough to admit the sleeve A^5; wherefore, in applying the sleeve A^5 to the nipple A^6 in the manner described, the shell A^4 is first dropped over said nipple, and afterward the sleeve is run down to its place. In order to permit this mode of applying the parts, the nipple A^6 should be of such length as to allow the shell A^4 to fall far enough to give a hold for the tongs or wrench upon the upper end of the sleeve.

A^3 is a terminal coupling or head piece connected with the higher adjacent upright A, which in Fig. 3 is shown to be single and in Figs. 1, 4, and 5 to be compound. The lower end of said coupling is of the same general form in all cases, being cylindrical and externally threaded to fit into the upper end of the shell A^4, and also being concaved on its under surface to fit the corresponding convex surface of the upper end of the sleeve A^5.

In making a junction of two adjacent sections of uprights by means of the device described, the nipple A^6, sleeve A^5, and shell A^4 are first connected with each other and the subjacent part A^7, and afterward the superjacent section, already provided with the foot-piece A^3, is let down upon the sleeve A^5. The concave and convex surfaces of these parts, by which the sleeve A^5 may enter the socket of the foot-piece A^3, insure the retention of these parts in proper relation while the shell A^4 is being raised and screwed upon the part A^3. Before being thus screwed to the coupling A^3, said shell is of course loose and free to be moved about, so as to be readily brought into proper alignment to screw upon the coupling A^3. The work of making this connection of said sleeve and coupling may therefore be performed with the utmost ease and deliberation.

In joining adjacent sections of tower-uprights by means of the coupling just described, the shells A^4 are first run up against the lower end of the sleeve A^5, but not so tightly as to be immovable thereon, after which the diagonal braces D are brought to proper tension to adjust the tower and give proper alignment to the several uprights. In this operation the parts of the joint described move enough to adjust themselves. Thereafter the shell A^4 may be further tightened up against the sleeve A^5 to any desired extent. The coupling described is essentially a ball-and-socket or universal joint, the sleeve A^5 corresponding to the ball; but as only slight movement of the joint is ever required, the ball is made incomplete, and only small provision is made by means of the spaces a and a' for the movement that takes place between the ball and the shell. This form of coupling is not only desirable in the structure of skeleton iron towers for the purpose of permitting adjustment of the diagonal braces, as above stated, but it is found to be very important in connection with the novel method of constructing such towers that will next be described, and which proceeds upon the plan of building from the top downward, and finally of seating a greater portion of the tower thus built upon the lower section or sections previously set permanently in place. This method of constructing this class of towers may be understood by reference to Fig. 7, wherein A A represent the uprights of the lower section of the tower, permanently set in place upon proper foundations, and provided with cross-girts B, so as to leave a hollow or free space within the same. Inside said section (which in dimensions will usually be from forty to ninety feet between the bases of adjacent uprights) the upper sections of the tower are successively erected, being lifted as fast as built, and the succeeding sections being added to the lower part of those previously constructed and raised.

In the operation of lifting the upper portion of the tower as fast as it is in this manner completed, section by section, the permanently-fixed lower uprights, A A, may serve as derricks, to the upper extremities of which are attached pulley-blocks H′, and to the lower parts of which are secured the windlasses H H. A rope, h, runs from each windlass through the upper pulley-block, H′, and through a second pulley-block, H^2, to which is attached a hook or other suitable device, h', by which a connection is made at each corner of the lower end of the structure to be raised. The part F is a false work, intended for lifting the upper portion of the tower T (when completed and ready to join with the base-sections A) so far above the lower sections, A, as to permit upright-sections A^8 to be inserted, as will be hereinafter further set forth; but said false work F may be here taken to represent the lower part of the upper portion of the tower to be raised by the windlass and tackle, and may indicate such upper portion of the tower lifted to the proper height from the ground to permit the insertion beneath it of uprights, diagonals, and cross-girts to form a next lower section of the tower. When the tower has thus been completed, with the exception of a single section, which is to rest upon the base-uprights A, a false work F longer than such section of the tower to be introduced is built beneath the upper portion of the tower T so far completed, being made smaller than the base of said upper portion, somewhat as illustrated, and adapted to support said upper portion by means of cross-pieces F′, extending beneath two adjacent girts, B, thereof, and secured thereto by clamps or any suitable form of fastenings, f. This false work F is engaged by the tackle in a manner entirely similar to that by which previously-raised portions of the tower have been engaged, and as illustrated in the drawings, and by means of such false work said upper portion, T, of the tower is hoisted to a sufficient

height above the base-uprights A to permit the insertion of the upright-sections A^8. These may be screwed into the upper couplings when the tower has been lifted only far enough from the ground for this purpose, or they may be inserted after such lifted portion of the tower is raised to the position shown. After the insertion of the upright-sections A^8, the upper part of the tower is lowered by means of the tackle until the coupling-nuts A^3, hereinbefore described, are seated upon the sleeves A^5, after which the shells A^4 are run upward to make the permanent connection, as already set forth.

In the operation of raising the towers a suitable number of guys, G, connected with the top of the tower are employed to steady the same, being operated for this purpose in the usual manner. After or while connecting the upper part of the tower, as described, the diagonals of the tower-section, of which A^8 A^8 are the uprights, are duly inserted. Thereafter, if necessary, the diagonals throughout the tower may further and finally be adjusted to bring the uprights into proper alignment, the flexible joints allowing the necessary relative movement of the parts aligned without destructive or injurious strain upon their connections.

If, under any circumstances, it is more convenient so to do, so much of the upper part of the tower as it is desired to construct from the ground before the first hoisting may be erected before the permanent base-section is put in place; or, if hoisting-screws and blocking are employed instead of the hoisting-tackle suggested, the base section or sections may be erected after the part T of the tower has been wholly completed. Of course screws and blocking may in any case be employed in conjunction with the tackle; but the latter alone are usually found sufficient and are more convenient and expeditious.

While in some cases the sleeve A^5 may connect directly with a single subjacent tubular upright, I prefer to employ the intermediate nipple, A^6, preferably made solid and of steel, so as to unite the greatest strength with small diametric size, in order that the flexible coupling may be as small as possible.

The eyes C and other features of construction shown form the subjects of other patents. The part A^5 is preferably made, as shown, in the form of a sleeve having an axial aperture of uniform diameter, or, in other words, being of equal thickness of metal throughout, for the reason that it will malleableize more perfectly and reliably, it being highly desirable that the joint shall be at once as strong and as light as possible. The coupling-nut A^3 is preferably apertured, as shown, for the same reasons. Of course, if for any reason preferred, both the sleeve A^5 and the said coupling-nut A^3 may be closed at their contiguous ends.

The false work F will usually be made as a skeleton iron frame, duly trussed, as shown, and ordinarily in two or more sections, separately added to the upper part, T, of the tower as the sections of said upper part have themselves been added. Said false work may, however, be of any other form. It is especially designed for use in conjunction with the hoisting-tackle, and requires to be of greater length than the uprights A^8, in order that while supporting the part T of the tower to the necessary height, as shown, it shall also depend within the base-section to give proper working connection with the tackle.

It is understood that I make no claim to the method, broadly, of building at the bottom of the tower, or, in other words, of raising a completed upper portion and adding to its lower end, since this has long been a common mode of erecting high structures. The invention is restricted to those structures which, as herein described, have a base section or sections broader than their upper part, whereby the former may be permanently placed and the latter erected within the same, and in which the junction of the upper and lower parts is made at a material elevation from the ground.

I claim as my invention—

1. In a skeleton iron tower, the combination, with the uprights, of universal-joint couplings uniting adjacent sections, substantially as described.

2. In a skeleton iron tower, the combination, with the adjacent tower-sections, of the sleeve A^5, having its ends rounded in the surface of a sphere, the correspondingly-socketed coupling-nut A^3, and the shell A^4, constructed to engage the lower end of the sleeve, and threaded to the nut A^3, substantially as described.

3. In combination with adjacent tubular tower-sections, the steel nipple A^6, sleeve A^5, shell A^4, and nut A^3, substantially as described, and for the purposes set forth.

4. The method, substantially as described, of constructing skeleton towers, which consists in building both upper and lower parts on the ground, the latter permanently in place, the former within the latter, and finally raising the upper part and connecting it to the lower part, substantially as described.

5. In combination with the permanently-set lower section of the tower, with an upper part of the tower erected within the same, and with suitable hoisting-tackle, a false work, F, of greater height than the length of the tower section or uprights to be inserted, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

JOHN S. ADAMS.

Witnesses:
M. E. DAYTON,
JESSE COX, Jr.