No. 730,799. PATENTED JUNE 9, 1903.

E. G. RUST.

BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED APR. 24, 1902.

NO MODEL. 7 SHEETS—SHEET 1.

Fig. 5.

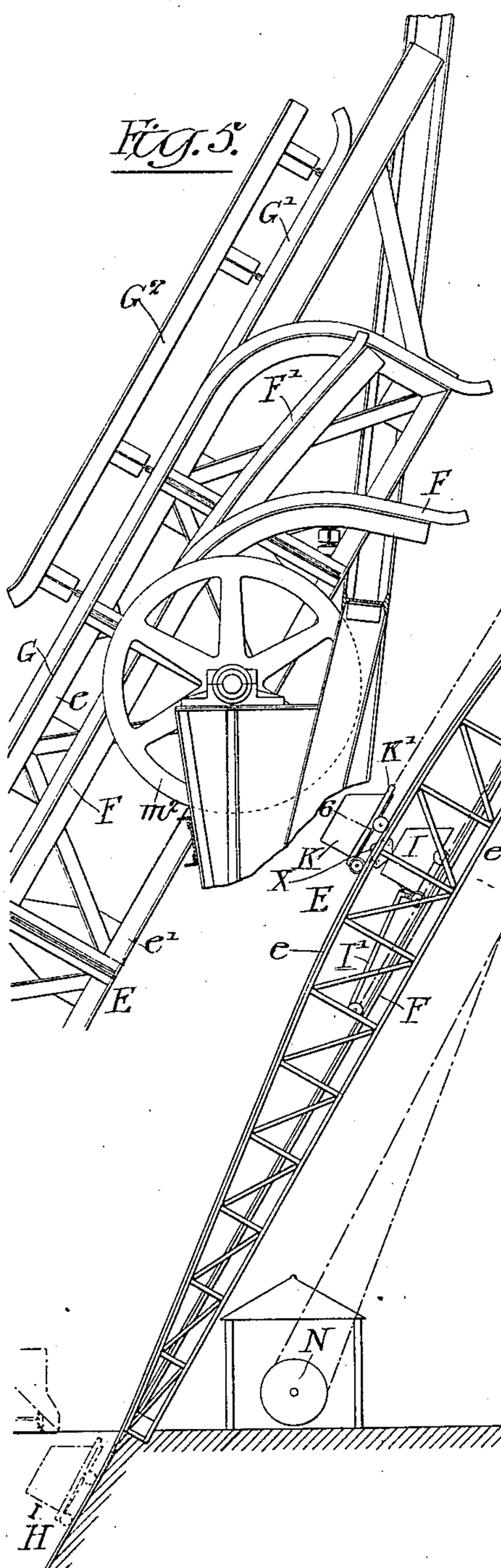
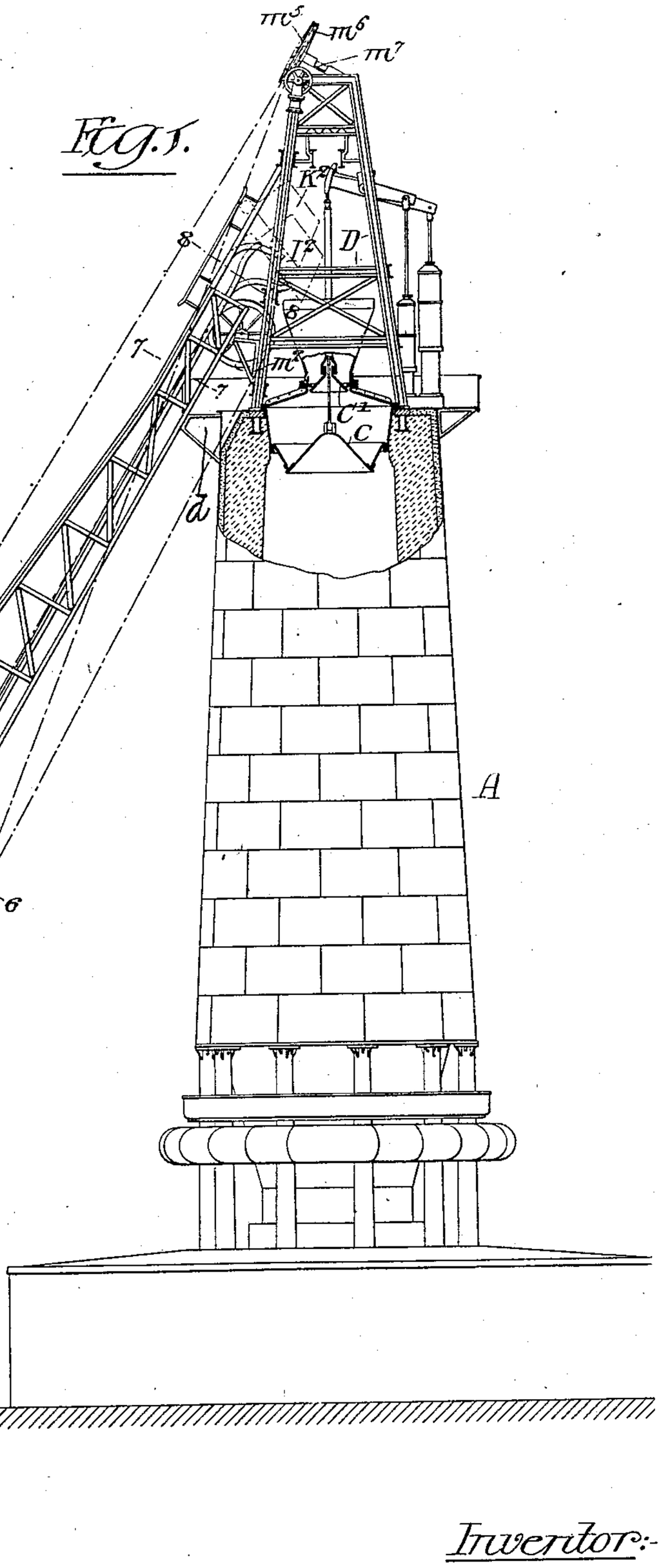


Fig. 1.



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Howson & Howson

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NO MODEL.

Fig. 2.

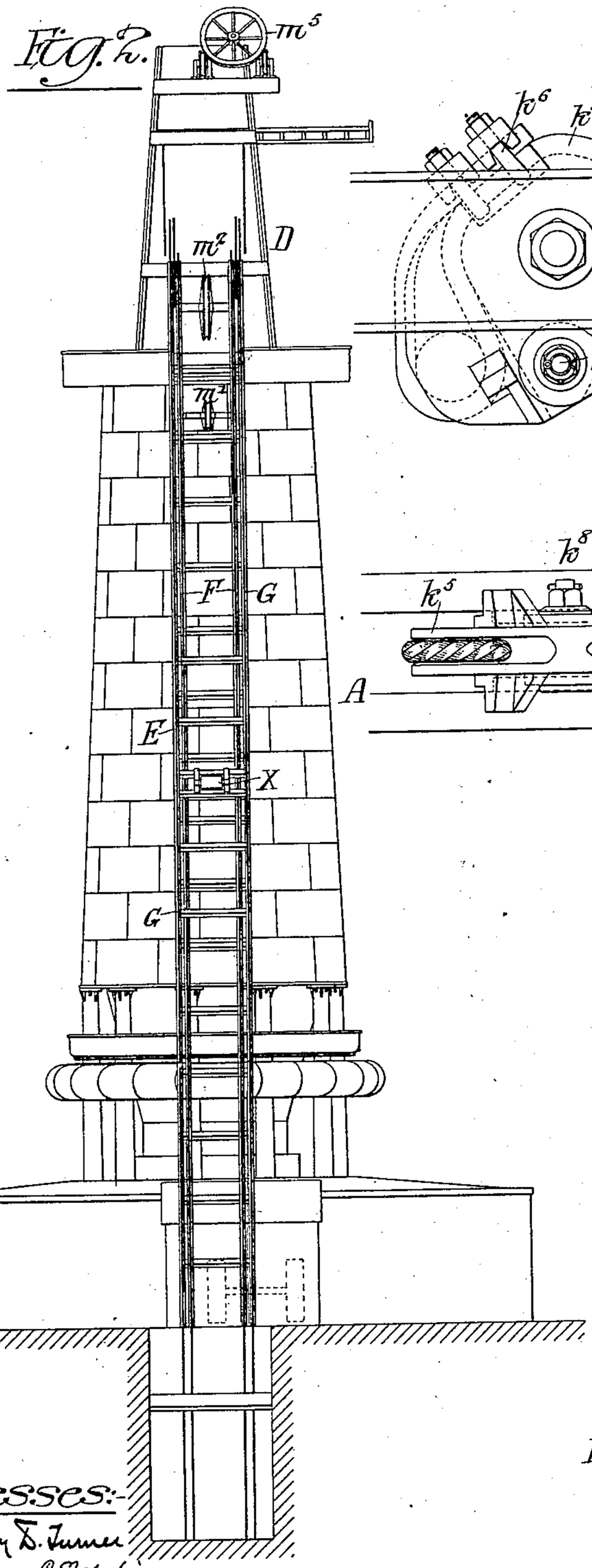


Fig. 15.

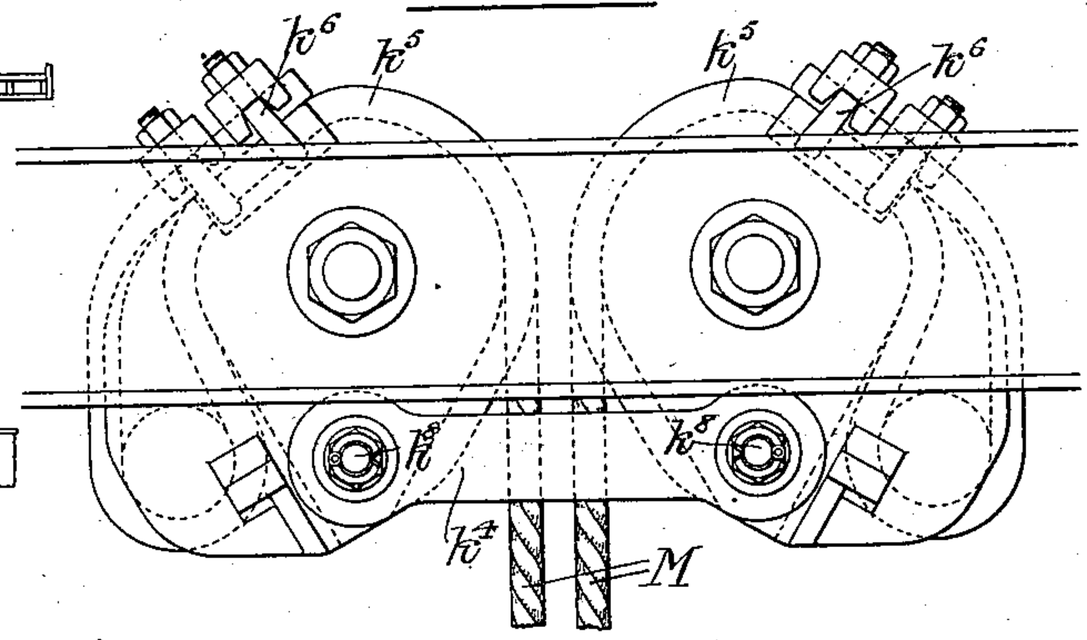


Fig. 16.

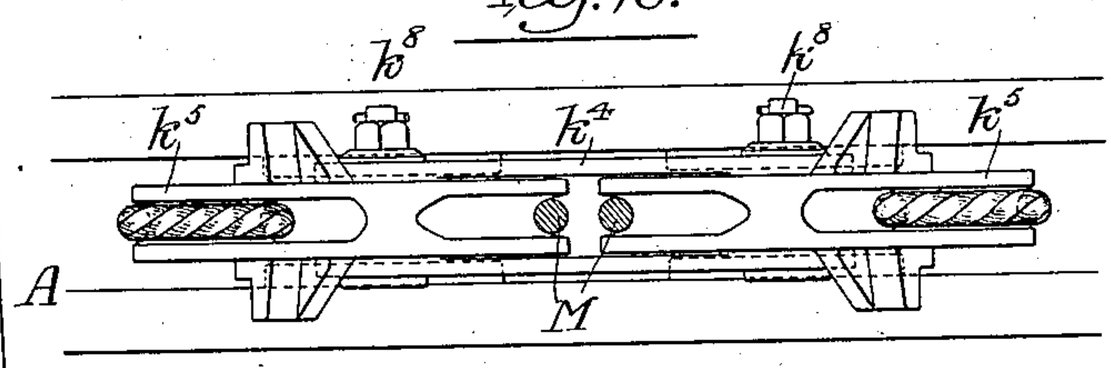


Fig. 7.

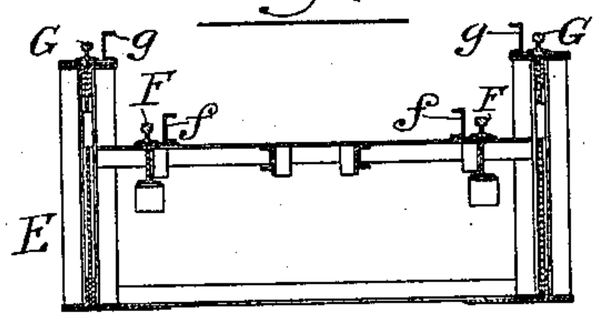
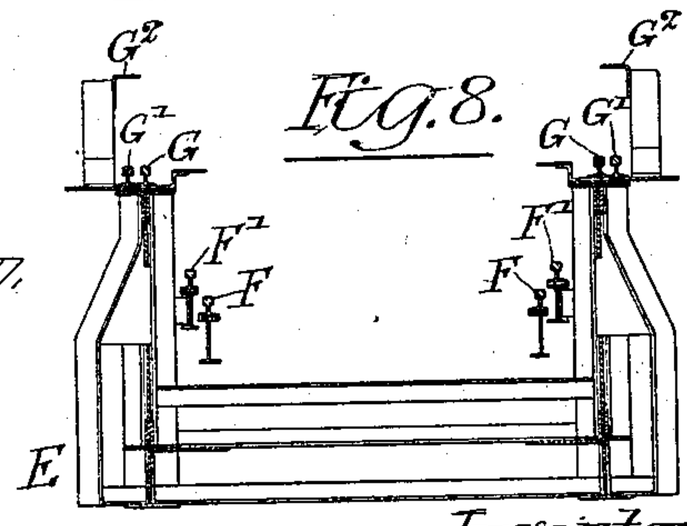


Fig. 8.



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NO MODEL. 7 SHEETS—SHEET 3.

Fig. 1.

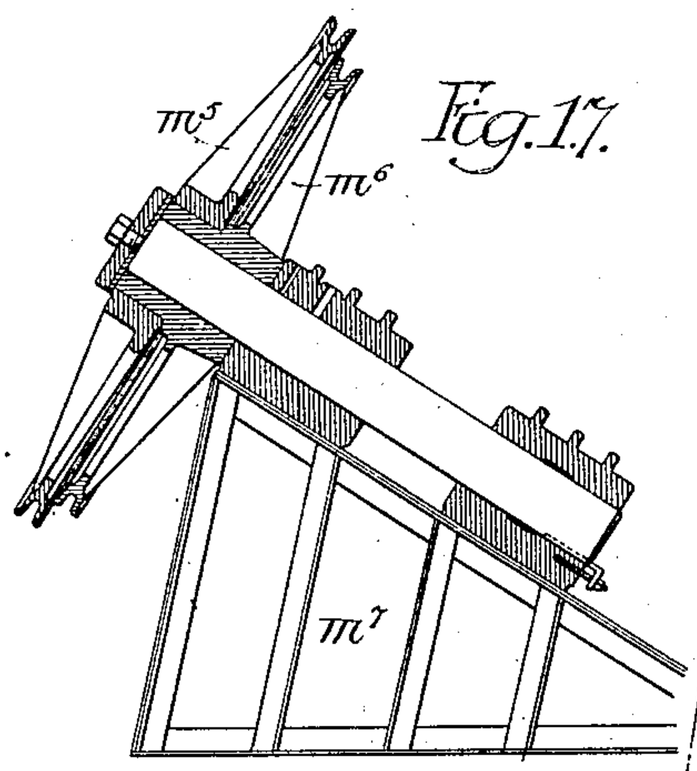
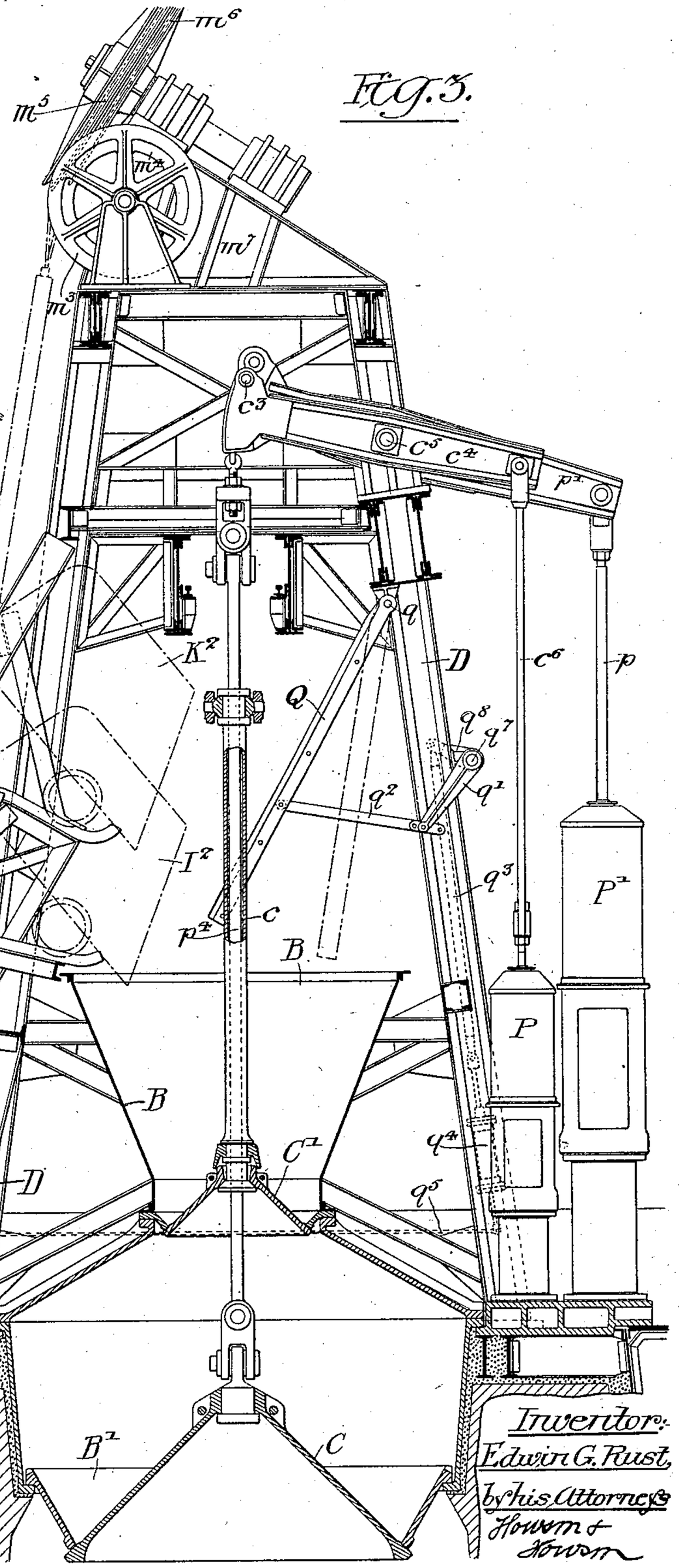


Fig. 3.



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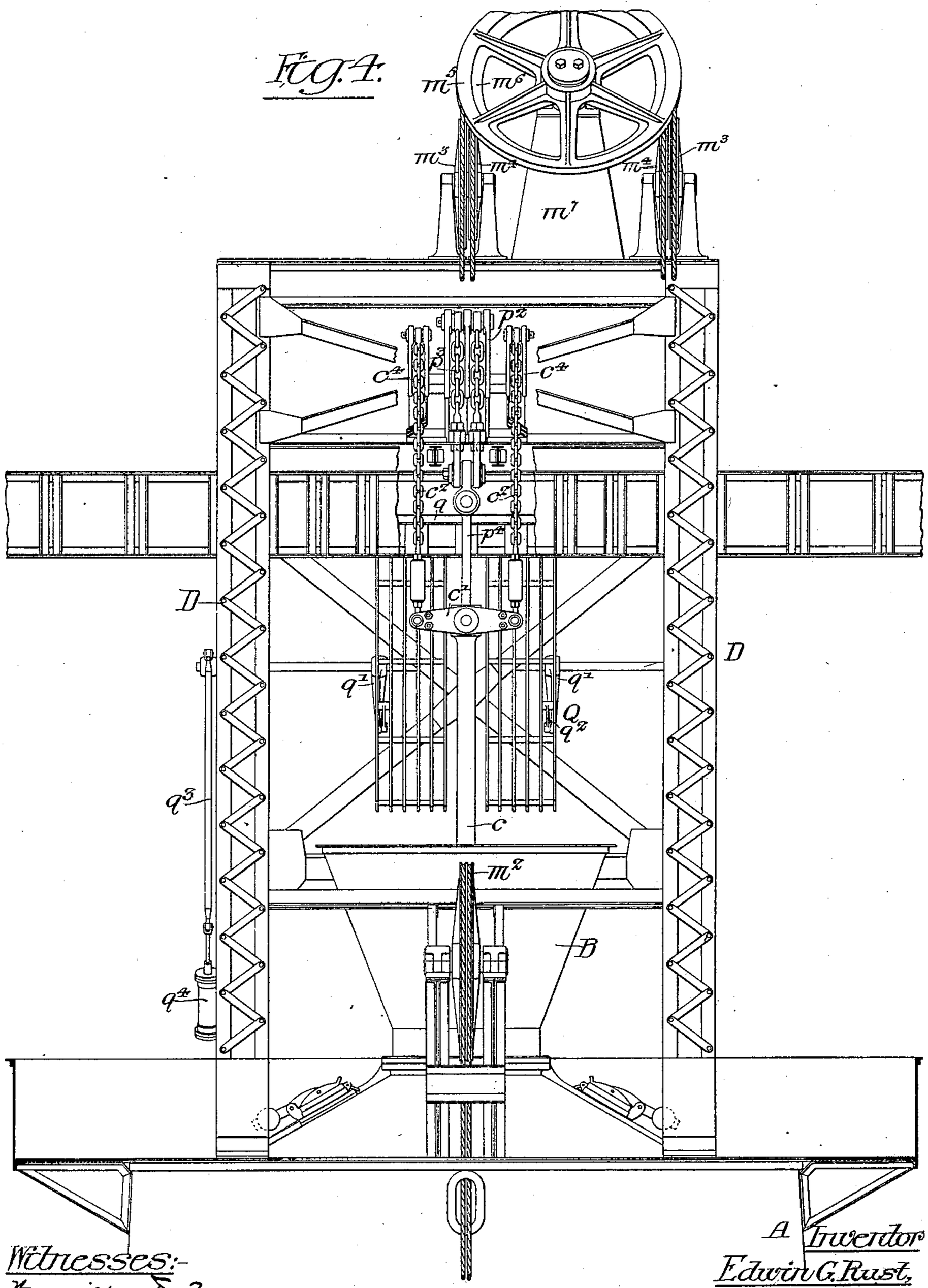
NO MODEL. 7 SHEETS—SHEET 4.

Fig. 4.



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BLAST FURNACE CHARGING APPARATUS.

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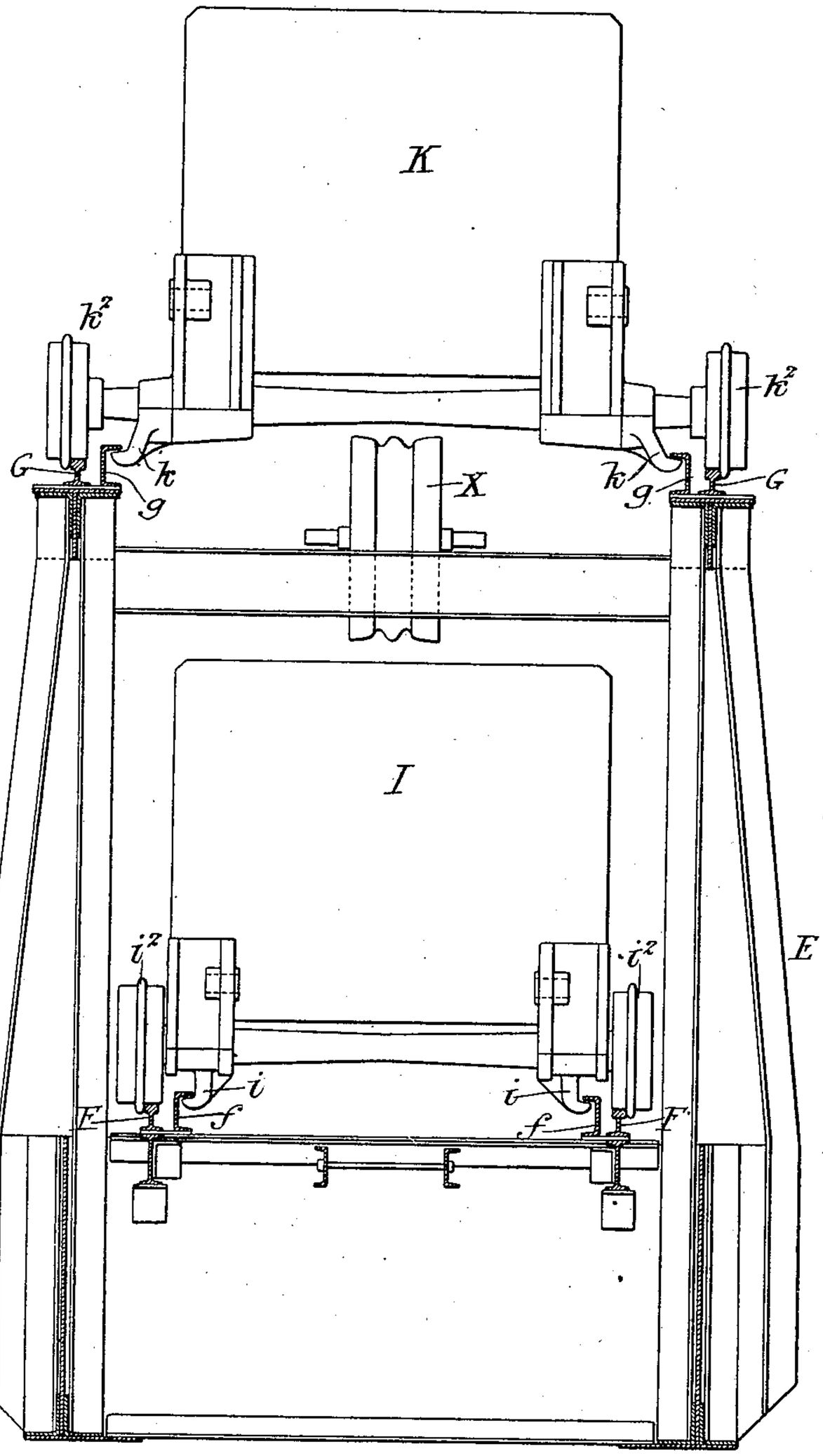
NO MODEL. 7 SHEETS—SHEET 5.

Fig. 6.



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NO MODEL. 7 SHEETS—SHEET 6.

FIG. 10.

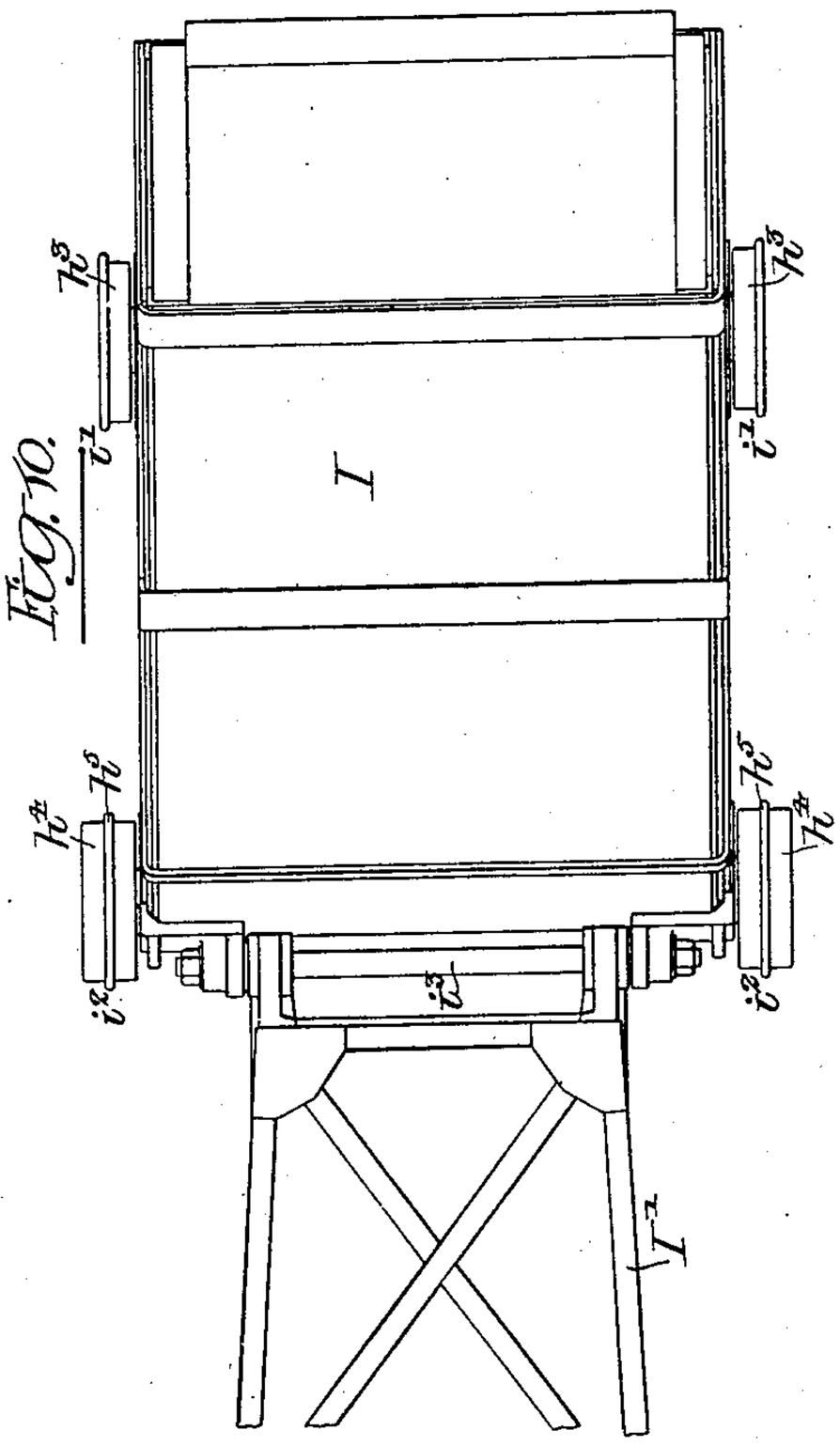


FIG. 9.

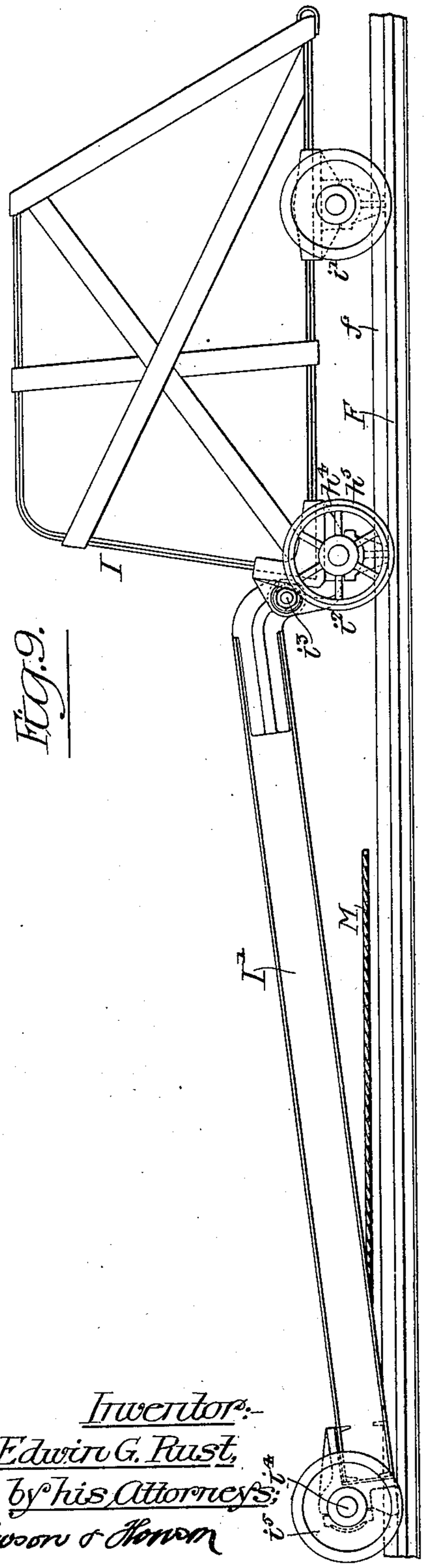
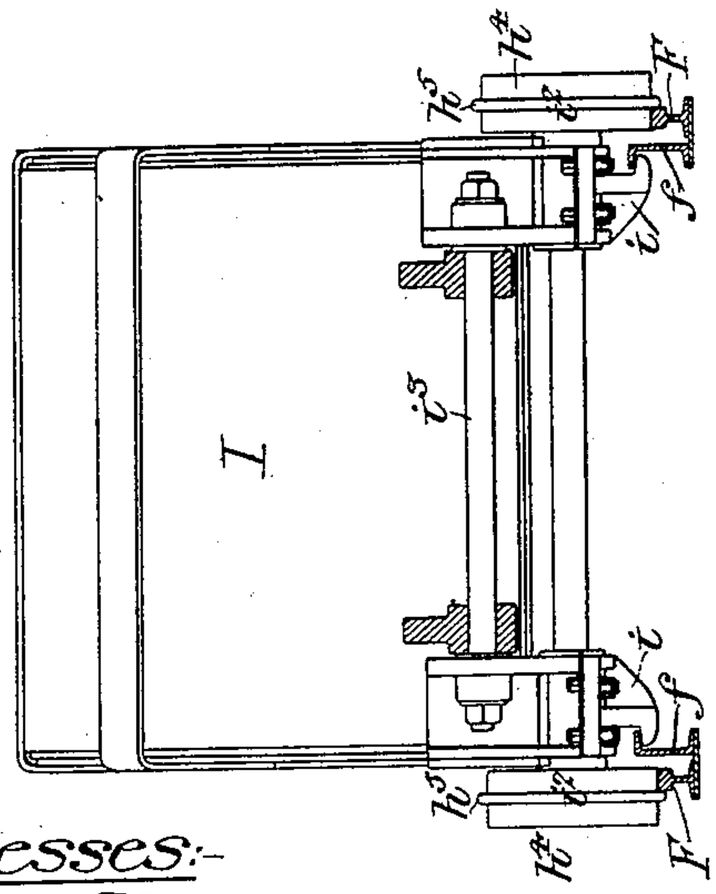


FIG. 11.



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BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED APR. 24, 1902.

NO MODEL. 7 SHEETS—SHEET 7.

Fig. 14.

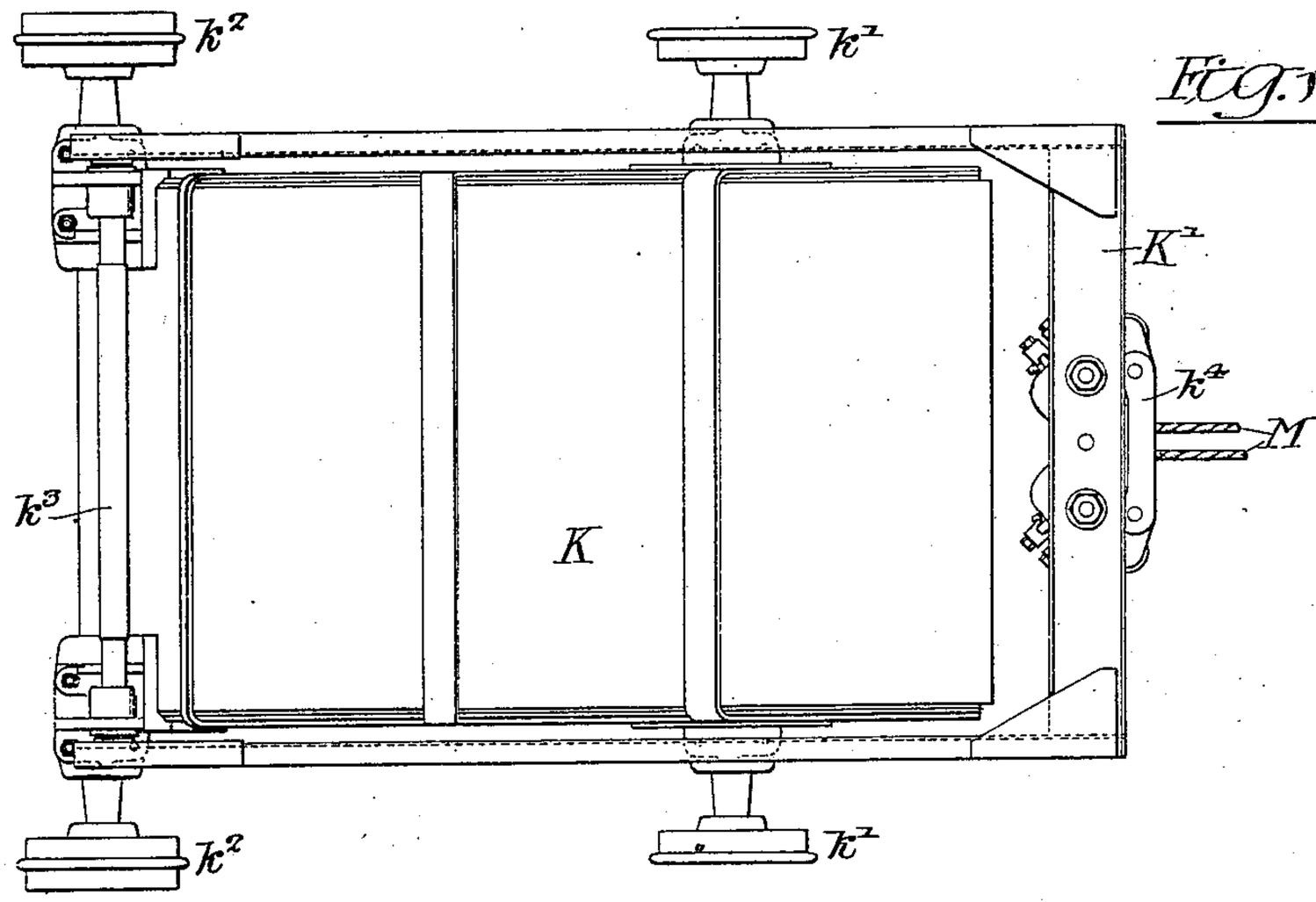


Fig. 12.

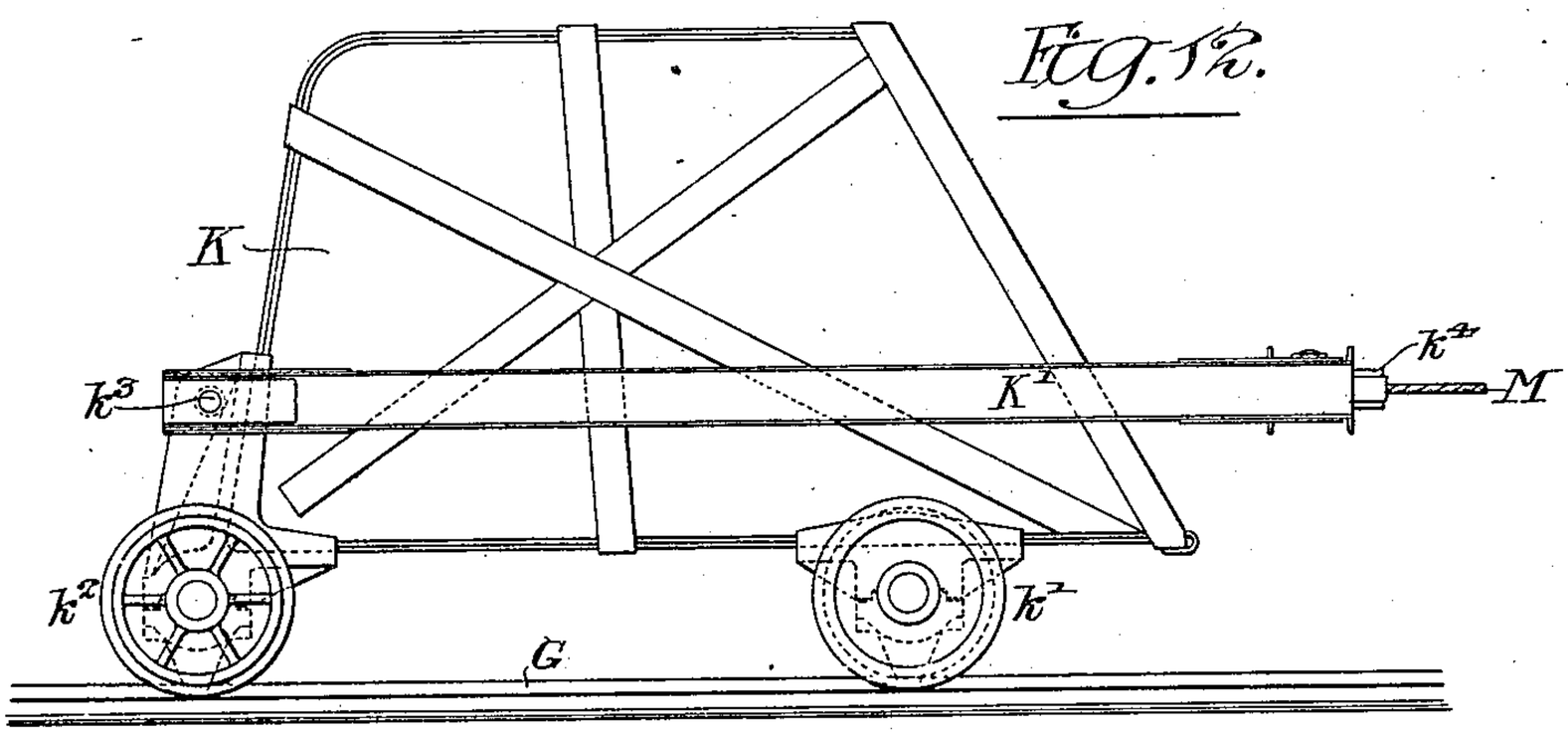
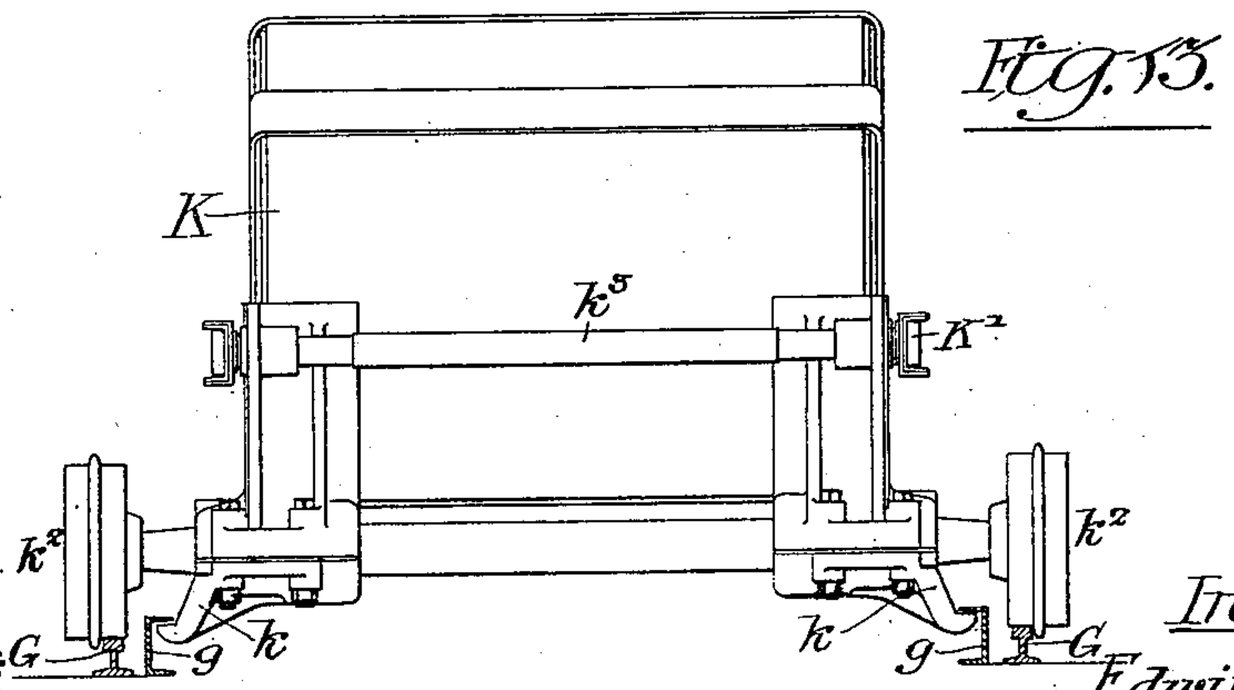


Fig. 13.



Witnesses:
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Howson & Howson

No. 730,799. Patented June 9, 1903.

UNITED STATES PATENT OFFICE.

EDWIN G. RUST, OF PUEBLO, COLORADO.

BLAST-FURNACE-CHARGING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 730,799, dated June 9, 1903.

Application filed April 24, 1902. Serial No. 104,470. (No model.)

To all whom it may concern:

Be it known that I, EDWIN G. RUST, a citizen of the United States, and a resident of Pueblo, Colorado, have invented certain Improvements in Blast-Furnace-Charging Apparatus, of which the following is a specification.

My invention relates to certain improvements in apparatus for feeding or charging stock to blast-furnaces, having for its object the provision of an improved device by which stock may be more efficiently supplied to a furnace than has heretofore been possible. These objects I attain as hereinafter set forth, reference being had to the accompanying drawings.

Figure 1 is a side elevation, partly in section, of a blast-furnace, showing my improved charging device attached thereto. Fig. 2 is a front elevation of the apparatus shown in Fig. 1. Fig. 3 is an enlarged side elevation of the mechanism at the top of the blast-furnace illustrated in Fig. 1. Fig. 4 is a front elevation of the mechanism shown in Fig. 3, the top of the bridge-truss being removed. Fig. 5 is an enlarged side elevation of the upper end of the truss structure. Fig. 6 is an enlarged sectional view of the bridge-truss shown in the preceding figures, taken on the line 6 6, Fig. 1. Figs. 7 and 8 are reduced sectional views of the bridge-truss, taken on the lines 7 7 and 8 8, respectively, in Fig. 1. Fig. 9 is a side elevation of the preferred form of the lower skip, showing the pusher attached to the same. Figs. 10 and 11 are a plan view and an end elevation, respectively, of the skip shown in Fig. 9. Fig. 12 is a side elevation of the preferred form of skip used on the upper track. Figs. 13 and 14 are end and plan views, respectively, of the same. Fig. 15 is a plan view of the equalizing device used for the attachment of the hoisting-cable to the skips. Fig. 16 is an end elevation of the device shown in Fig. 15, and Fig. 17 is a sectional elevation of the main sheaves, taken through their supporting-spindle.

It will be understood by those skilled in the art that in charging blast-furnaces while it is important that the stock be deposited at the center of the hopper of the furnace it has hitherto been difficult to accomplish this end in view of the fact that the hoisting apparatus usually employed is customarily provided with tracks side by side and lying in the same inclined plane. This construction has the disadvantage of bringing the skips to the top of the dumps at opposite sides of the center of the hopper and besides depositing material at the sides of the receiving-hopper requires a relatively wide track structure or bridge, making it necessary to provide a correspondingly wide framework at the top of the furnace, a place where the saving of room laterally is of great importance.

By my improved apparatus I overcome the disadvantage inherent in the above-described device and provide a construction and arrangement of parts which have been found to overcome the above-mentioned objection in an efficient and satisfactory manner.

In the above drawings, A is a blast-furnace of any desired construction provided at the top with a hopper B and having gas-tight bells C and C′, by means of which stock is introduced into the interior of the furnace without the escape of gas. Carried on the top of the furnace proper is a framework D, supporting part of the mechanism for operating the gas-bells, there also being in the present instance a bracket *d*, fixed to the side of the furnace proper, against which rests the upper end of the lower member of the truss *e′*. The other end of this bridge structure rests on the ground and is provided with any suitable foundations and anchors, the whole being inclined to the perpendicular, preferably at an angle of about thirty degrees, as will be seen from an inspection of the figures. The truss E carries two sets of tracks F and G, respectively, of different gages, that of the lower track F being less than that of the upper. The said lower track is preferably, but not necessarily, straight or in one plane, supported on suitable brackets and beams of the truss proper. From Figs. 6, 7, and 8 it will be noticed that these lower tracks F are inside of the planes of the vertical members forming the connection between the upper and lower members *e* and *e′* of said truss, while the upper tracks G are placed vertically over said vertical members, being outside of the vertical plane including the lower tracks F.

From Fig. 1 it will be noted that while the

two sets of tracks in the loading-pocket H are in the same plane as soon as they come upon the truss structure the upper tracks G are bent or curved in a vertical plane and are preferably convex to the line of the lower and inner tracks F, the truss structure itself being built to accommodate this arrangement. The greatest distance between the two sets of tracks is near the center of the truss structure, and from here to the top of said structure the members thereof, and consequently the upper tracks G, approach the lower tracks, finally becoming parallel with them, although not necessarily in the same plane.

The construction of the top part of the truss structure may be best understood by reference to Figs. 3 and 5. From these it will be seen that near their upper ends both the tracks F and G are curved downwardly almost at right angles to their normal direction. At points just before these curved portions begin there are auxiliary tracks F′ and G′, respectively, fixed to suitable supporting structures and placed in each instance outside of the main tracks F and G. They continue to extend nearly in the same plane as that of the tracks F and G, although the track F′ is given a slight downward bend or curve, as shown. The other auxiliary tracks G′ are provided with a guard-rail G^2 for a purpose hereinafter set forth. The extreme ends of each set of tracks are turned up, as shown, to prevent the possibility of the skips running off of them.

Located near the center of the bridge-truss and nearly in the plane of the upper chord is the idler-sheave X, as shown in Figs. 1 and 6. The object of this idler-sheave is to carry the hoisting-rope attached to the car K when this is on that part of the bridge which lies below the said sheave, and thereby to hold the ropes in proper position and prevent them from interfering with the passage of car I up or down the bridge.

Paralleling each of the two sets of tracks F and G for their entire length are channel-irons *f* and *g*, respectively, suitably supported and placed to receive hooked projections *i* and *k* from the axle-bearings of each skip. These projections preferably extend from a piece forming the lower half of said axle-bearings, and being held in place by any desired means are readily removable when it is desired to take the skips from the tracks for any reason. The object of the said channel-irons and the hook projections *i* and *k* is to form guards which will prevent the possibility of the cars leaving the track while my improved charging apparatus is in operation in case there should be any tendency to such action due to obstructions or from any other cause.

The skips I and K are of ordinary construction of body and are provided in front with wheels i' and k', having external flanges. The wheels i^2 and k^2 on the rear axles, however, are of double width of tread and have a flange projecting from the center of said tread, as shown, the tread of the front wheels being in line with that part of the tread of the rear wheels which is between the flange and the car-body.

Pivoted to suitable castings at the rear of the skip I is a pusher I′, consisting of a frame held to said skip by a bar i^3 and having its rear end supported on an axle i^4, provided with flanged wheels i^5, constructed to travel on the track F.

The body of the skip K is of practically the same dimensions as that of the skip I, although the axles for the wheels k' and k^2 are of a length to accommodate them to the gage of the tracks G, and the hooked guard-pieces *k* are also modified, as shown, to meet the difference of construction due to the same cause. A three-sided frame or bale K′ is pivoted to the rear of this skip by means of a bar k^3, the said frame normally extending around the car and having an equalizing device to be described hereinafter for the attachment of the pair of hauling-cables M. The cable for hauling the other skip I is fastened to a similar equalizing device on the rear end of the pusher I′ and extends forward under the pusher and skip.

Referring to the equalizing device above mentioned and which is shown in detail in Figs. 15 and 16, it will be seen that this consists of two sectors k^5, which are connected together at their outside ends by means of links k^4 through suitable pins k^8. Each of the two hoisting-ropes M are passed around one of these sectors, to which they are securely held by means of clamps k^6.

The operating or hauling cables M pass from the equalizing device on the bale K′ over a system of sheaves, to be described hereinafter, suitably carried on the top of the framework D and down to a drum N of a hoisting-engine, preferably located on the ground. From this drum the same or another set of cables pass around a double sheave m^2 and down to the equalizing device on the rear of the pusher I′. In view of the fact that the upper skip has to travel over a greater distance than the lower one the hoisting-engine is preferably provided with two drums, that for the portion of cable connected to said upper skip being of slightly-greater diameter than that for the other.

By reference to Fig. 3 it will be seen that the upper gas-bell C′ is set in the bottom of the hopper B, being supported by a tubular bar *c*, which in turn is suspended from two chains c^2, attached to a cross-piece c', fixed to the upper end of said bar. Said chains are fixed at c^3 to the upper ends of curved guide-pieces forming the ends of levers c^4, pivoted at c^5 to the framework D on the top of the blast-furnace. To the other end of the said levers is attached a forked rod c^6, the lower end of this rod being connected to the

piston-rod of a cylinder P, carried on the framework D and having within it a piston of any desired construction. A similar cylinder P′ is also supported on the said framework and has a piston-rod p, connected to a second lever p', extending between the two levers c^4, while being supported upon the same pivot c^5 which supports said levers. The opposite end of this lever p' is provided with a curved guide-piece p^2, to which are attached chains p^3, engaging with a rod p^4. At its upper end this rod extends within the hollow bar c and its lower end is fastened to the lower gas-bell C. Any desired piping and valve mechanism is provided for the two cylinders P and P′, and it will be noted that by their use the two gas-bells C and C′ may be operated independently of each other.

A grating or deflector Q, preferably rectangular in outline, is pivoted to the framework D at q, being placed above the hopper B and on the side of the framework opposite to that against which this upper end of the bridge-truss E is inclined. The purpose of this grating or deflector is to direct the course of the lumps discharged from the upper skip-car to the side of the hopper nearest the bridge, in this way distributing the said lumps on both sides of the hopper, since those from the lower car are naturally thrown to the side of the hopper opposite the bridge. The fine material from the upper car will pass through the open spaces in the grating and not be materially deflected from its natural course.

The deflector Q is connected by means of levers q' and q^2 and shaft q^7 to another lever q^8, which in turn is connected by a rod q^3 to a piston within a cylinder q^4, which cylinder is connected to a source of steam or other pressure supply by means of any suitable valve and piping.

The valve-operating mechanism for governing the flow of fluid under pressure to the cylinder q^4 includes a bar q^5, which runs across the framework D and is pivoted to a lever q^6, placed at the side of one of the upper tracks G on the bridge structure. The arrangement is such that the controlling-valve of the said cylinder will be automatically operated by the wheels of the upper skip-car as this approaches the top of the bridge, so as to throw the deflector into its angular position, as shown by the full lines in Fig. 3, and similarly to throw it out of this position to that shown in dotted lines as the car again passes down the bridge, it being noted that by this means the deflector is moved so that there is no interference with the discharge of material from the lower car into the hopper.

In operation the cables are of such length that one skip is in a position for dumping its contents at the top of the furnace while the other is in the loading-pocket H. If now the hoisting-engine be started, the loaded skip—for example, the one, K, running on the upper track—will be drawn toward the top of the furnace, while the other will be permitted to descend on the lower track under the influence of gravity. These two will meet and one skip will pass over the other at the point of maximum separation of the two sets of tracks, the upper skip K continuing to approach the top of the furnace, although its bale turns on its pivot slightly at an angle to the plane of the bottom of the skip. Just before reaching the top the front pair of wheels k' drop forward, following the curved ends of the track G, while the outside tread of the rear wheels runs onto the tracks G′, the hoisting-cable continuing to raise the car and causing it to assume the position shown in dotted lines at K^2, Fig. 3, with its rear wheels running upward along the tracks G′. The bale K′ is now swung at an angle of more than ninety degrees from the plane of the bottom of the skip and any material within the car is discharged into the hopper of the furnace. Upon reversing the direction of motion of the hoisting-engine the weight of the bale and of the heavy rear wheels of the skip K causes it to run down its track and to regain its normal position thereon, while the loaded skip on the lower track is drawn upward. It will be noted that this latter is propelled through its pusher I′, to which the hoisting-rope is attached, and, as before, it passes the skip K on its way to the top of the bridge and is dumped in a manner similar to that of the other skip, assuming in so doing the position illustrated at I^2 in Fig. 3. The pusher of course remains on the main track F, its use being necessary in order to secure the best operation of the cars. After dumping and when the direction of motion of the hoisting-engine is again reversed the weight of the pusher draws the skip I into its normal position and together with its own weight causes it to descend toward the loading-pocket.

The operation of the equalizing device for the double cables is as follows: Should one of the said cables M become slack, thus throwing the strain on the other rope, the sector k^5, to which the tight rope is attached, will turn in the direction of the pull on the rope, moving the other sector by means of the connection through pin k^8 and links k^4 in the opposite direction, shortening the slacked rope and proportionally lengthening the tight rope, in this way equalizing the tension on both of said ropes.

Referring to the preferred system of sheaves, at the top of the framework D is a pair of sheaves, around which are passed the cables for hoisting the skip-car K, which are of special construction, so as to make it possible to employ the double-rope suspension for the said upper skip-car. Instead of having one double sheave, as is the usual practice, there are two large main sheaves m^5 and m^6 of different diameters supported in an oblique

plane. The former of these preferably has the greater diameter and is placed above and independent of the other sheave, the whole being suitably carried upon an inclined framework m^7, as illustrated in Fig. 17. The sheave m^5 preferably rotates on an extension of the hub of sheave m^6, and it is seen that by having the two sheaves of different diameters the two hoisting-cables are brought out on each side thereof in different vertical planes, as shown by Fig. 4. Under the cables are placed sheaves m^3 and m^4, supported on the framework D, the sheaves m^4 being smaller in diameter than the sheaves m^3, but rotating on the same centers. In this way each of the hoisting-cables is fully supported in the plane of its own main sheave without the possibility of interference with its operation.

Whenever desired, the valve mechanism connected to the cylinder P is operated to lower the bell C′, thus admitting any material contained in the hopper B into the lower hopper B′, which is closed to the furnace proper by means of the bell C. After the bell C′ has been again closed this second bell C is operated independently of the other and the charge deposited within the furnace.

I claim as my invention—

1. In an apparatus for charging stock to a blast-furnace, &c., the combination of two sets of tracks one above another leading to the charging-opening of the furnace, each set of tracks having an independent discharge device with cars constructed to operate upon said tracks, substantially as described.

2. In an apparatus for charging stock to a blast-furnace, the combination of two sets of tracks, one above the other, both leading to the charging-opening of the furnace, said tracks being in the same plane at the bottom and each having an independent discharge device at the top, with cars constructed to operate on said tracks, substantially as described.

3. In an apparatus for charging stock to blast-furnaces, the combination of a truss structure, two rigidly-connected sets of car-tracks thereon, passing one over the other, with cars constructed to operate on said tracks, and means for operating the cars, substantially as described.

4. In a charging apparatus, for blast-furnaces, the combination of a truss structure, two sets of rigidly-connected tracks thereon, arranged in substantially the same vertical plane, cars constructed to operate on said tracks, said truss structure being constructed to allow of said cars being loaded from the same point and being provided with means whereby the cars are caused to dump at substantially the same point, with means for operating the cars, substantially as described.

5. The combination in a blast-furnace-charging apparatus, of a truss structure connecting a loading-pocket with the top of the furnace, two sets of tracks of different gage on the truss, constructed to allow cars to pass each other in a vertical plane, cars for said tracks, and means for operating the cars, substantially as described.

6. In a blast-furnace-charging apparatus, the combination of a truss structure, two sets of tracks thereon of different gage, one set of the same passing over the other set, a car for each set of tracks, means for simultaneously raising one car and lowering the other, with means for automatically causing the cars to dump their contents when they reach the top of the truss structure, substantially as described.

7. The combination of a truss structure having two sets of tracks one above the other, cars constructed to operate on the said tracks and to pass each other at substantially the point of maximum separation of the sets of tracks, one car having a pusher behind it and the other having a bail extending to its front whereby the ends of a cable are attached to the cars, means for causing the cars to dump their contents at the top of the furnace and means for simultaneously raising one car and lowering the other, substantially as described.

8. The combination of a truss structure, two sets of tracks passing over one another carried by the same, cars constructed to operate upon the tracks, and to pass each other at substantially the point of maximum separation of said sets of tracks, a frame extending behind one car and pivoted thereto, a frame pivoted to the other car and extending in front of the same, a cable attached to each of said frames and mechanism connected to the cables for simultaneously raising one car and lowering the other, substantially as described.

9. The combination of a truss structure, two sets of tracks thereon, said tracks passing over one another, the upper set of tracks being of wider gage than the lower set, two cars constructed to operate on said tracks, and to pass each other at substantially the point of maximum separation of said sets of tracks, the car for the lower track having pivoted to it a pusher-frame, a bail pivoted to the car for the upper track, hoisting mechanism, cables connecting the bail and the pusher with said mechanism and means for dumping the cars at the top of the frame, substantially as described.

10. The combination of a truss structure, two sets of tracks thereon of different gage, sections curved in vertical planes connected to the upper ends of said tracks, auxiliary tracks for each of the two sets of the same, cars operating on the tracks, and means for raising and lowering the cars, substantially as described.

11. The combination of a truss structure, two sets of tracks of different gage thereon, the upper ends of said tracks being curved in vertical planes, auxiliary tracks adjacent

to the upper ends of said main tracks, and cars constructed to operate on the tracks, with means for causing each of said cars to operate upon one pair of tracks until it approaches the top thereof and then causing one pair of wheels to continue upon the main track and the other pair to run upon the auxiliary tracks, thereby dumping the car, with means for raising and lowering the cars, substantially as described.

12. The combination of a truss structure, two sets of tracks of different gages thereon having their upper ends curved in vertical planes, auxiliary tracks with one end adjacent to said upper ends of the main tracks, cars operating on the tracks, each car having single-tread front wheels and double-tread rear wheels, the said wheels running upon the main tracks until the car approaches the top thereof, and the said cars being provided with means permitting the front wheels to follow the curved portion of the main track and the rear wheels to run upon the auxiliary tracks, thereby dumping the car, with means for moving the cars upon said tracks, substantially as described.

13. In a charging apparatus of the character described, the combination of a truss structure having tracks, guard-rails inside of and paralleling the same, cars constructed to operate upon the tracks and provided with bearings between their wheels, said bearings having means constructed to coöperate with said guard-rails whereby the wheels of the car are retained upon the tracks, substantially as described.

14. In a charging apparatus of the character described, the combination of a truss structure having tracks, channels forming guard-rails paralleling the same, cars constructed to operate upon the tracks, said cars having hooked projections from their bearings constructed to extend under the flanges of said channels, thereby retaining the wheels of the cars upon the tracks, substantially as described.

15. The combination of a blast-furnace, a truss structure carrying tracks extending from the ground to the top of said furnace, cars constructed to run on said tracks, a double cable connected to the cars, a hoisting-engine, sheaves of different diameters for the double hoisting-ropes, supported by the truss structure, substantially as described.

16. The combination of a blast-furnace, a truss structure carrying tracks extending from the ground to the top of said furnace, cars constructed to run on said tracks, a double cable connected to the cars, a hoisting-engine, sheaves of different diameters for the double hoisting-ropes supported by the truss structure in an oblique plane, said sheaves each having independent idler-sheaves for said cables, substantially as described.

17. In a charging apparatus of the character described, the combination of a furnace having tracks extending to the top thereof, cars for said tracks and a double cable for operating the cars, two independent main sheaves of different diameters carried by the furnace structure for the said cables and idler-sheaves below said main sheaves, substantially as described.

18. In a charging apparatus of the character described, the combination of a furnace having tracks extending to the top thereof, cars for said tracks and a double cable for operating the cars, two independent main sheaves of different diameters carried by the furnace structure for the two cables and two pairs of idler-sheaves below said main sheaves, the sheaves of each of said pairs being independent of each other and also of different diameters, substantially as described.

19. In a charging apparatus of the character described, the combination of a structure connecting a loading-pocket with the top of the furnace, tracks on said structure, cars on the tracks having a double cable whereby they are operated and means for automatically equalizing the strain on the cables, substantially as described.

20. In a charging apparatus of the character described, the combination of a structure connecting a loading-pocket with the top of the furnace, tracks on said structure, cars on the tracks, a double cable for operating the cars, devices connecting one end of each cable to a car with means whereby the strain on the cables is automatically equalized, substantially as described.

21. In a charging apparatus of the character described, the combination of a structure connecting a loading-pocket with the top of the furnace, tracks on said structure, cars on the tracks, a double cable for operating the cars, sectors revolubly pivoted to a car to which an end of each cable is attached and a link connecting the sectors, whereby motion of one causes motion to the other, substantially as described.

22. In a charging apparatus of the character described, the combination of a structure connecting a loading-pocket with the top of the furnace, tracks on said structure, cars on the tracks having a double cable whereby they are operated and a double sheave for the cables, the members of said sheave being free to move independently of one another, substantially as described.

23. In a charging apparatus of the character described, the combination of a structure connecting a loading-pocket with the top of the furnace, tracks on said structure, cars on the tracks having a double cable whereby they are operated and a double sheave for the cables, the members of said sheave being free to move independently of one another, one of said sheaves having a projection from its hub and the other sheave being carried on said projection, substantially as described.

24. In a charging apparatus for blast-furnaces, the combination of a truss structure having tracks, guard-rails paralleling the

same, cars constructed to operate upon the tracks, bearings upon the cars for the axles thereof, said bearings having a detachable portion provided with a projection placed to coöperate with the guard-rails whereby the wheels of the car are prevented from leaving the track, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWIN G. RUST.

Witnesses:

AXEL H. HELANDER,

HENRY B. RUST.