J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

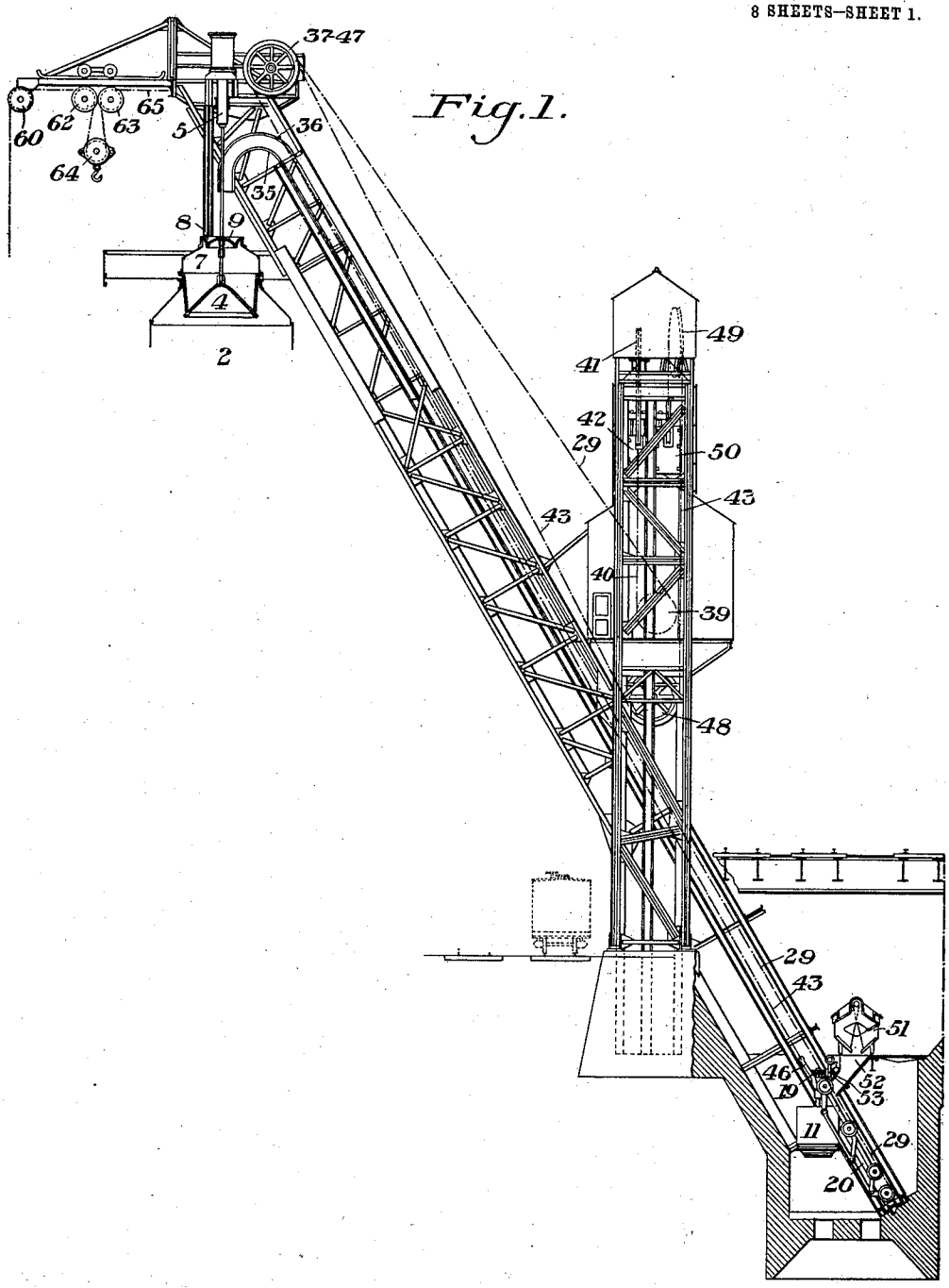
APPLICATION FILED OCT. 20, 1910.

992,670.

Patented May 16, 1911.

8 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

R. A. Baldwin

W. Famariss

INVENTOR

Julian Kennedy

by Bakewell Byrnes & Parmelee

his Attys

J. KENNEDY.

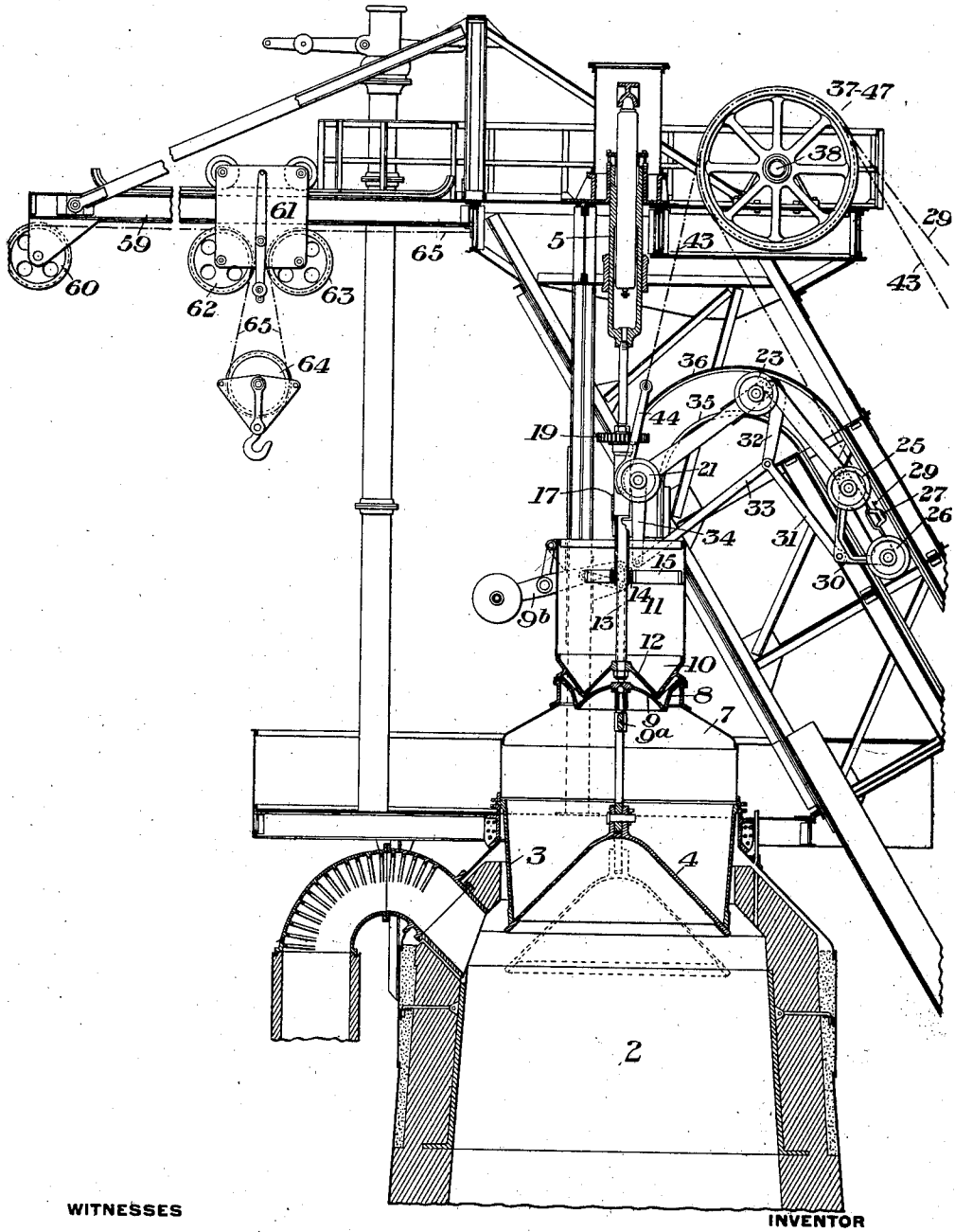
BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED OCT. 20, 1910.

992,670. **Patented May 16, 1911.**

8 SHEETS—SHEET 2.

Fig. 2



WITNESSES

R. A. Balderson

W. Famariss.

INVENTOR

Julian Kennedy

By Cushman Darby & Cushman

his attys

J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

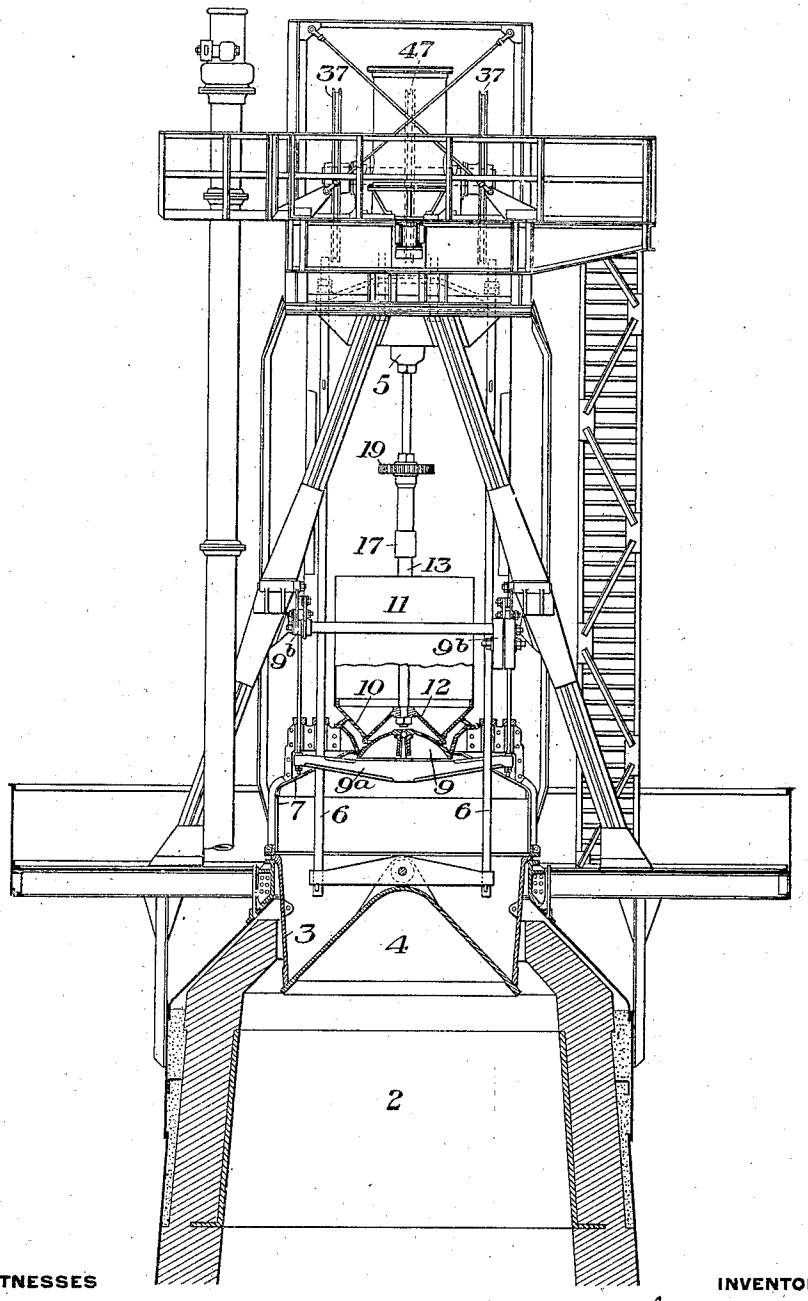
APPLICATION FILED OCT. 20, 1910.

992,670.

Patented May 16, 1911.

8 SHEETS—SHEET 3.

Fig. 3.



WITNESSES

R. A. Balderson

W. Famariss

INVENTOR

Julian Kennedy

by Bakewell Byrnes & Barnwell

his attys

J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED OCT. 20, 1910.

992,670. Patented May 16, 1911.

8 SHEETS—SHEET 4.

Fig. 6.

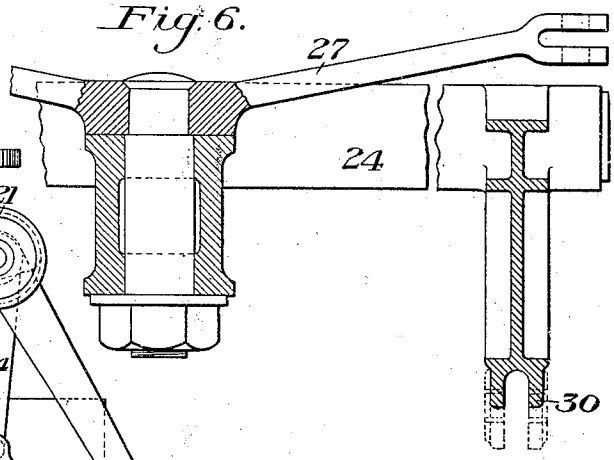
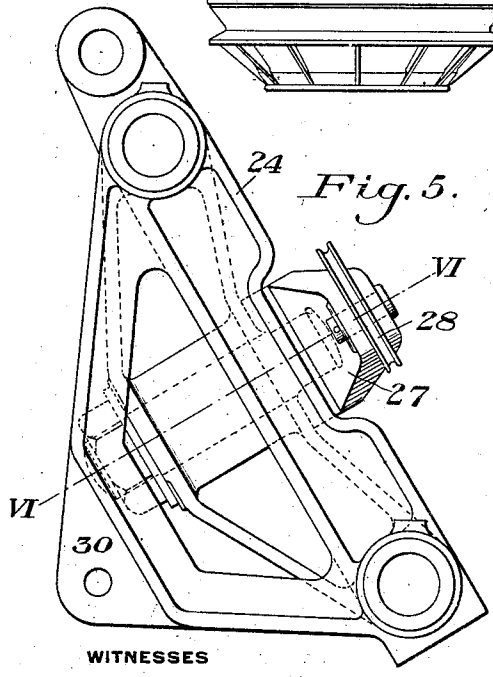


Fig. 4.

Fig. 5.



WITNESSES

R. A. Balderson

W. Famariss

INVENTOR

Julian Kennedy

By Behrens Byrnes & Sommerville

his attys

J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED OCT. 20, 1910.

992,670.

Patented May 16, 1911.

8 SHEETS—SHEET 5.

Fig. 7.

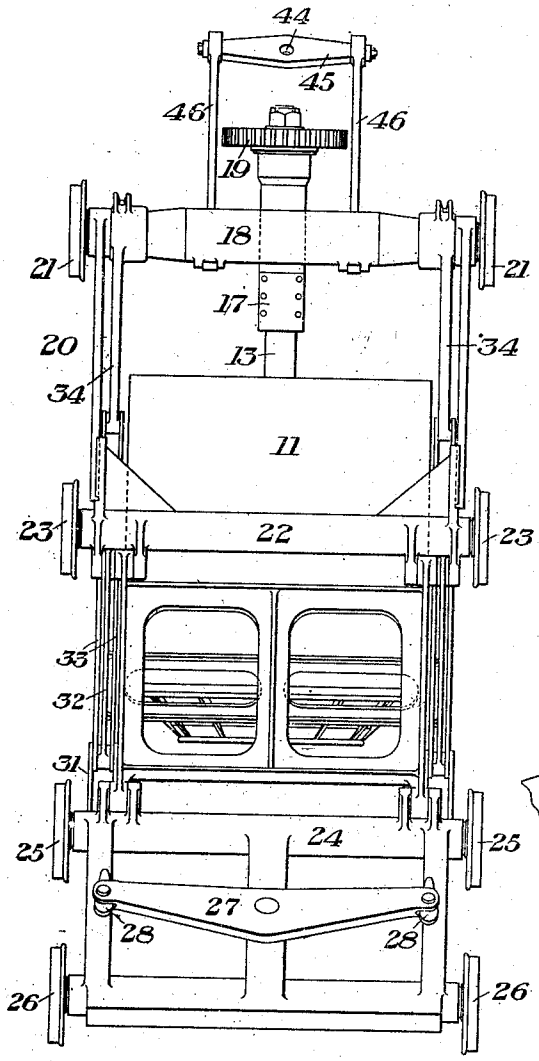
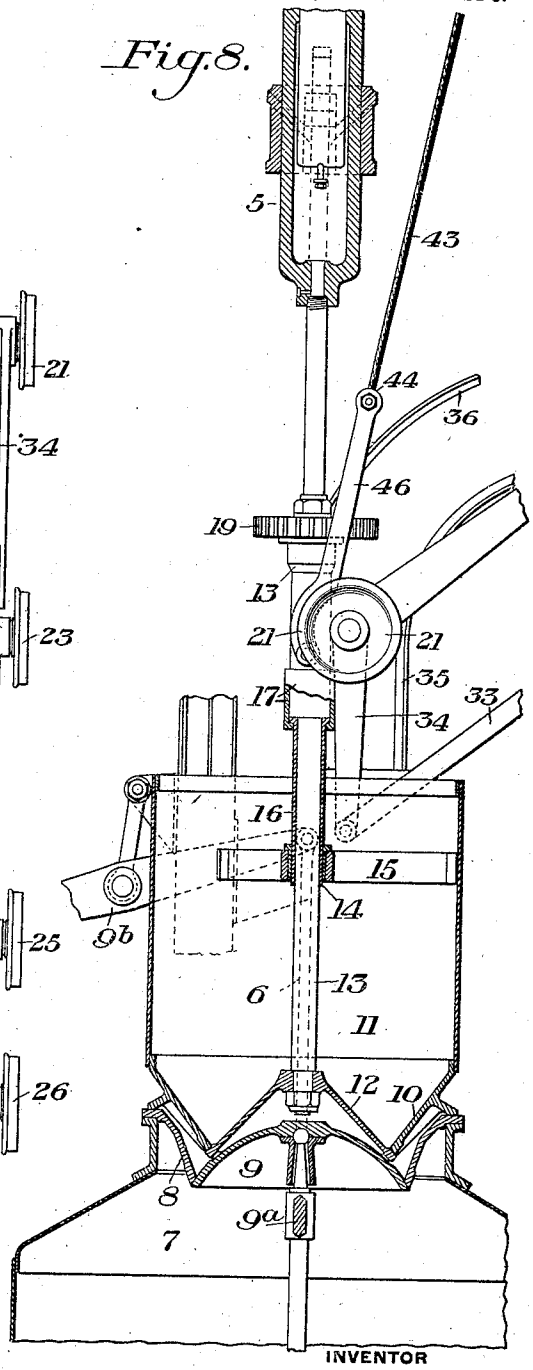


Fig. 8.



WITNESSES

R. A. Balderson

W. Famariss

INVENTOR

Julian Kennedy

by Parker, Byrnes & Parmelee

his attys

J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED OCT. 20, 1910.

992,670.

Patented May 16, 1911.

8 SHEETS—SHEET 6.

Fig. 9.

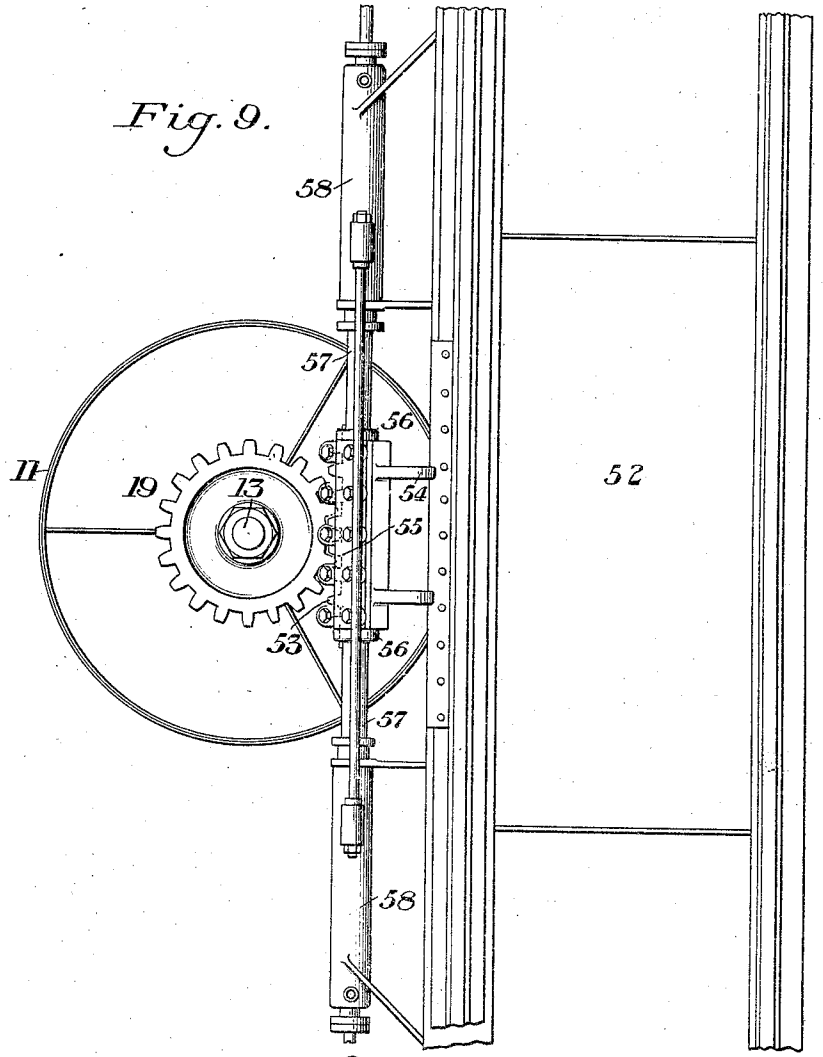
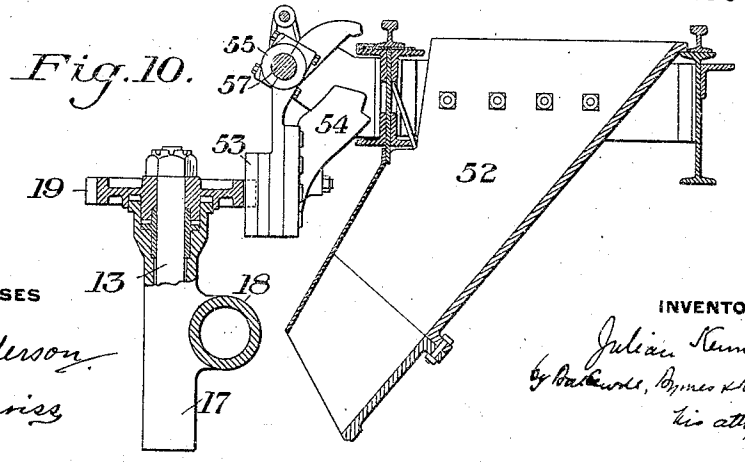


Fig. 10.



WITNESSES

R. A. Balderson

W. Famariss

INVENTOR

Julian Kennedy

by Baldwin, Byrnes & Lamberton

his attys

J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED OCT. 20, 1910.

992,670. **Patented May 16, 1911.**

8 SHEETS—SHEET 7.

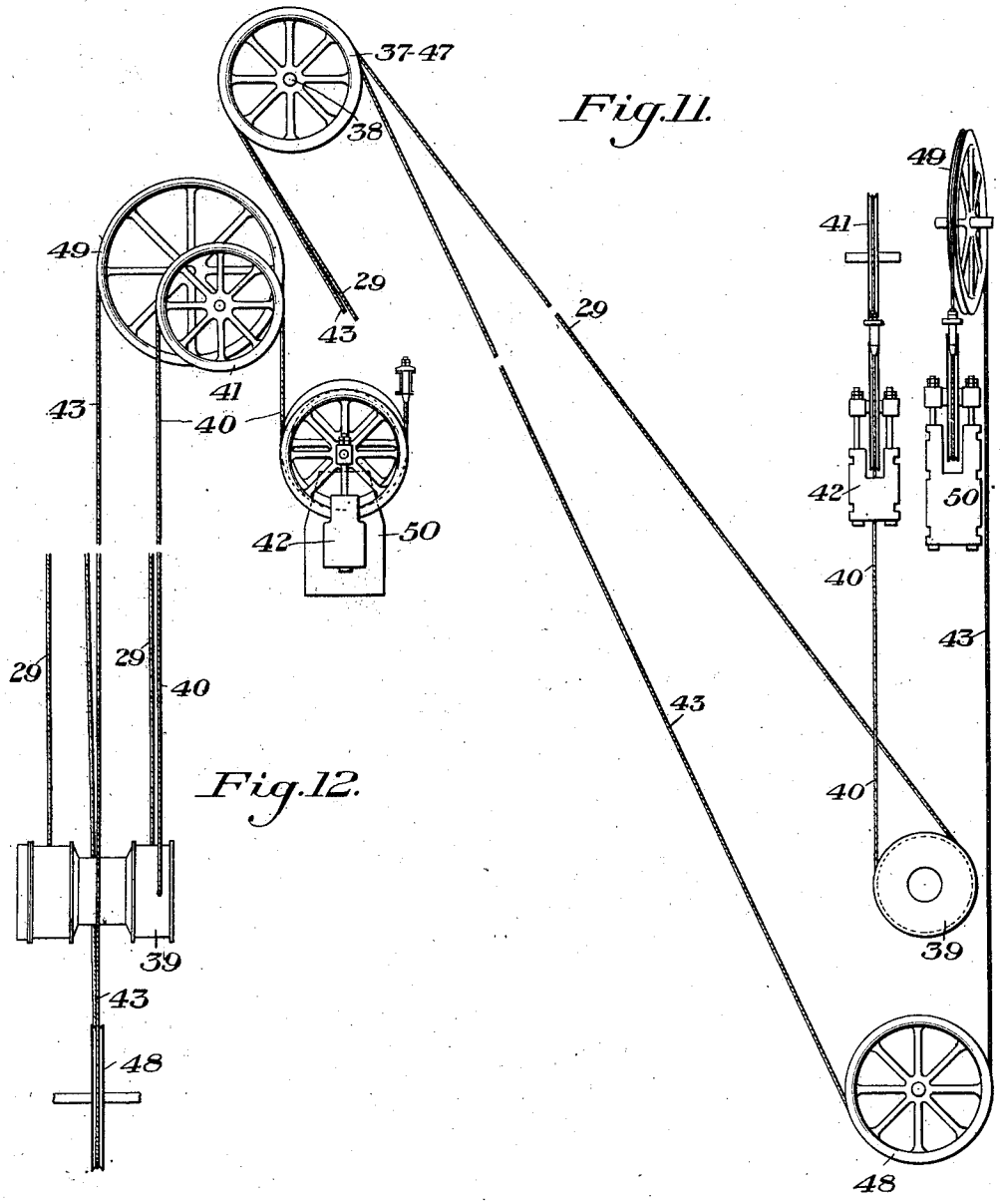


Fig. 11.

Fig. 12.

WITNESSES

R. A. Balderson

W. Fairarish

INVENTOR

Julian Kennedy

by Bakewell, Byrnes & Farnsler

his attys.

J. KENNEDY.

BLAST FURNACE CHARGING APPARATUS.

APPLICATION FILED OCT. 20, 1910.

992,670. Patented May 16, 1911.

8 SHEETS—SHEET 8.

Fig. 13.

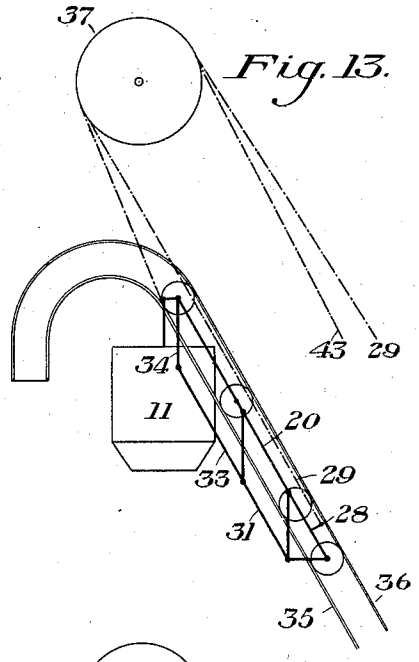


Fig. 14.

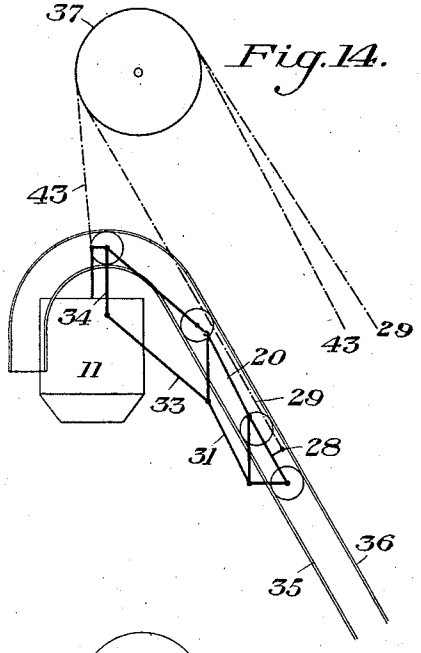


Fig. 15.

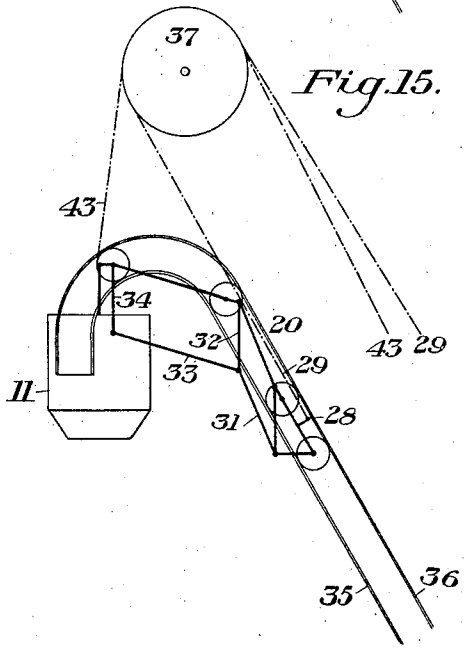
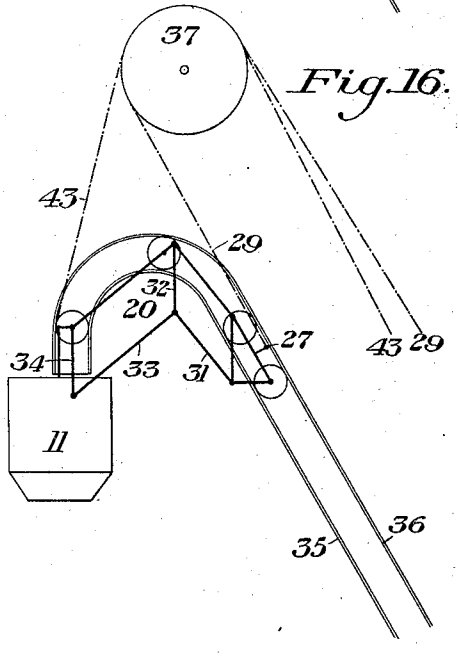


Fig. 16.



WITNESSES

R. A. Balderson

W. Famariss

INVENTOR

Julian Kennedy

by Bakewell Bates & Bromley

his attys

UNITED STATES PATENT OFFICE.

JULIAN KENNEDY, OF PITTSBURG, PENNSYLVANIA.

BLAST-FURNACE-CHARGING APPARATUS.

992,670. Specification of Letters Patent. Patented May 16, 1911.

Application filed October 20, 1910. Serial No. 588,100.

To all whom it may concern:

Be it known that I, JULIAN KENNEDY, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Blast-Furnace-Charging Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional side elevation showing a preferred form of my apparatus for charging blast furnaces; Fig. 2 is an enlarged sectional side elevation showing the upper portion of the incline, the bell apparatus, etc.; Fig. 3 is a sectional front elevation similar to Fig. 2; Fig. 4 is an enlarged side elevation of the bucket and skip carriage; Fig. 5 is an enlarged side elevation of the lower frame portion of the skip carriage; Fig. 6 is a cross section on the line VI—VI of Fig. 5; Fig. 7 is a rear elevation of the skip carriage shown in Fig. 4; Fig. 8 is an enlarged section showing the bucket ready to discharge into the hopper; Fig. 9 is a top plan view of the rack for turning the bucket; Fig. 10 is a sectional side elevation of the same, showing the charging chute. Fig. 11 is a side view of the rope, counterweight and drum arrangement; Fig. 12 is a front elevation of the same, and Figs. 13 to 16 are diagrammatic views showing the different positions of the carriage and bucket at the top of the incline.

My invention relates to blast furnace charging apparatus, particularly that of the type wherein a hanging bucket is supported from a skip carriage.

The object of the invention is to provide simple and effective means for preventing swinging of the bucket.

It is also designed to provide an improved counterweight system, which will also serve to cushion the lowering movement of the bucket upon the top of the furnace, and also to provide improved mechanism for turning the bucket to different angular positions in order to distribute the stock.

In the drawings, 2 represents the upper portion of a blast furnace having the usual feed hopper 3, and discharge bell 4 therefor, this discharge bell being shown as operated by a power cylinder 5, through suitable yoke connections 6, extending up through the top 7, of the hopper outside of the lines of the charging bucket when in position. The top of the hopper is provided with a central opening having a funnel or hopper 8, closed by counterweighted bell 9, having a cross head system 9^a connected to the counterweight link system 9^b. The top of this hopper is provided with a suitable seat to receive and support the lower conical portion 10 of a charging bucket 11 having a bell-shaped closure 12. This bell 12 is carried on a central stem 13, extending upward through a guide bearing 14, held by a spider 15, within the bucket. A bushing 16 surrounds the upper portion of the reduced diameter lower half of the stem or rod 13, the upper end of this bushing being flanged and resting within the lower part of a sleeve 17, which surrounds the upper enlarged diameter portion of the rod. The sleeve 17 is preferably formed integrally with a casting constituting the front truck 18 of the articulated carriage. Above the casing or sleeve portion of this front truck, the stem or support 13 is provided with a toothed wheel 19.

The carriage 20 is articulated, having the front truck 18 provided with track wheels 21, an intermediate truck 22 provided with track wheels 23, and a rear truck 24 preferably formed as a steel casting, shown in Figs. 5 and 7, carrying two sets of track wheels 25 and 26. In end view, this rear truck is triangular, forming a rigid frame. Centrally pivoted to the upward portion of the rear truck is a cross head 27, the ends of which are provided with attachments 28, to which are secured the ends of two wire ropes 29, which act as hoisting ropes. Each truck is provided in its lower portion with two webs 30, to which are connected links 31, pivotally connected to levers 32, which, in turn, are pivoted to the intermediate truck. To these levers 32 are also pivoted links 33, whose front ends are pivotally connected with levers 34, which are keyed to the front truck. This link and lever system forms a parallel motion device at each side of the bucket, which will hold the bucket in vertical position and prevent swaying or swing-

ing so long as the rear truck wheels are on a tangent or straight portion of the inclined track 35. This inclined track comprises upper and lower rails 35 and 36, which extend straight to above the top of the furnace, and thence are curved over and downwardly and inwardly to a proper point to bring the bucket into seating position on the intermediate hopper.

In Figs. 13 to 16, inclusive, I show in heavy black lines the parallel link system in its different positions, as the carriage reaches and passes beyond the uppermost portion of the trackway. From these diagrams, it will be seen that so long as the rear truck wheels are on the straight portion of the track, the bucket is rigidly maintained in its true vertical position and held against swaying or swinging while being guided accurately to its seating position on the hopper.

I will now describe the rope and counterweight system. The ropes 29 extend from the swinging equalizing cross head of the rear truck, pass upwardly to and over sheaves 37, keyed or otherwise secured to a shaft 38 on the top of the furnace, thence down to a drum 39, to which they are secured. This drum is fastened to a power driven shaft connected to the hoisting engine. To the opposite side of the drum and winding in an opposite direction is a rope 40, which extends upwardly to and over a sheave 41, and thence down to a counterweight 42. Another single counterweight rope 43 has one end secured at 44 to a bail cross head 45, having bails 46, pivotally connected to the front truck. The lower portions of these bails are preferably curved, as shown in Figs. 4 and 8, to avoid contact with the truck in certain positions. The rope 43 extends upwardly over an intermediate sheave 47, loosely mounted on the shaft 38, and thence down to and around a sheave 48, up to and over a sheave 49, and down to counterweight 50. The counterweight rope 43 aids in moving the carriage up the inclined track and the entire counterweight system forms an overweight which will normally draw the carriage with its load up the inclined track.

The counterweight 50 is preferably the heavier of the two counterweights and when the front truck wheels reach the highest point of their travel and begin to descend the inwardly and downwardly curved portion of the trackway, this counterweight will oppose this downward motion and hence slow down and cushion the stop of the bucket as it reaches its seat on the hopper. I am thus enabled to do away with separate cushioning devices to slow down this final movement and obtain this action through the counterweight system itself, which cooperates with the engine in moving the carriage along the inclined track.

As before stated, the bucket-supporting rod or stem is provided with a toothed wheel 19, secured at its upper end, and this toothed wheel is used for turning the bucket to different angular positions in a horizontal direction to provide a better distribution of the charge. This turning movement is imparted when the bucket is in its filling position at the lower portion of the trackway, as shown in Figs. 1 and 10. When the bucket has been filled from the lorry 51, through the chute 52, the toothed wheel 19 is at this time in mesh with a rack 53. This rack is provided with a counterweight 54 to hold it yieldingly in mesh with the toothed wheel and is hung from a loose sleeve 55, mounted between collars 56 of the common piston rod 57, of two single acting cylinders 58. The cylinders 58 are in line with each other, are horizontal and their stroke is such that when motive fluid is supplied to one of them and the piston pushed through its stroke, the gear wheel will be turned about a third of a revolution. In the use of the system, the first load is filled into the bucket and the bucket is hoisted without turning. When the next charge is supplied, fluid pressure is fed to one of the motive cylinders and the bucket is turned a third of a revolution. On the next charge, the bucket may be turned another third of a revolution, and on the next charge, it may be held without turning. These three different positions of the bucket are provided for insuring a better distribution of the charge. On the descent of the bucket to its filling position, the toothed wheel 19 will come into mesh with the rack 53, and if the car moves slightly below its true position, this will not cause any injury to the coacting teeth on account of the pivoted supporting of the rack on its actuating piston.

In the operation of the system, when the bucket has been filled at the lower end of the inclined track and turned, if desired, through a part of a revolution, the usual brake on the rope drive system is released to allow the counterweights to draw the carriage and load to the top of the furnace. When the front truck reaches the highest part of its travel, the counterweight 50 begins to oppose its further movement, and the engine then moves the carriage to the end of its travel, opposing this counterweight. A slow cushioning final travel is thus obtained. In the last part of its travel, after the bucket has been seated on the hopper 8, the carriage has a slight further movement which moves the stem and bell 12 downwardly and forces the bell 9 downwardly against its counterweight connections. The bucket is thus opened and the load discharged into the

main hopper and upon the main bell 4. The hoisting engine is then started in the reverse direction and as the stem rises, the bell 12 engages the conical bottom of the bucket and lifts it, the bell 9 rising again to its closing position to prevent escape of gases. The carriage then travels back to the bottom of the track, the counterweights being carried up during this lowering of the carriage and empty bucket. Power is exerted during this descending of the carriage, owing to the overweight system. To assist in removing the main bell, I preferably provide on the top work of the furnace a trackway 59, having an outer sheave 60, secured thereto. On this trackway moves a trolley 61, having sheaves 62 and 63, between which is a depending block 64. A rope 65 is secured to the top work of the furnace and thence extends over sheave 63 around the sheave of rope block 64, thence over sheaves 62 and 60 and down to an actuating drum or member (not shown). By moving this trolley along the track to the proper positions, the rope block may be used for hoisting or lowering the bell or other parts, and by inserting a rod or bar in one of the holes of the sheaves 62 and 63, the trolley may be caused to travel inwardly or outwardly along the track, and at the same time, raise or lower the rope block. This is of considerable advantage in removing and replacing bells, etc.

The advantages of my invention will be obvious to those skilled in the art. All non-swaying or cushioning or slow-up devices at the top of the furnace which are picked up by the carriage are done away with and the shocks and jars incident thereto are also done away with, as well as the resulting complication. The carriage itself through its parallel motion connections insures the holding of the bucket in the proper vertical position, preventing swaying and swinging and guiding the bucket to its proper seating position. This is all self-contained on the carriage, thus giving a continuous smooth movement. The use of the counterweight system for the front portion of the truck causes this counterweight to assist in counterweighting the carriage and load, while at the same time, it acts as a slow-down and cushioning device for the seating movement of the bucket. The turning system for the bucket is simple and effective and is arranged to avoid liability to injury.

Many changes may be made in the form and arrangement of the various systems without departing from my invention.

I claim:

1. In blast furnace charging apparatus, an inclined trackway leading to the top of a furnace, a carriage movable on the track and adapted to change its angle with relation thereto, a bucket suspended from the carriage, and mechanism carried by the carriage and arranged to prevent swaying of the bucket, said mechanism also being arranged to be automatically shifted during the angular change of position of said carriage to maintain the bucket in a vertical position during such change; substantially as described.

2. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, a bucket suspended from the carriage, and a self contained bucket seating device on the carriage arranged to maintain the bucket in a vertical position, said mechanism also being arranged to be automatically shifted during the angular change of position of the said carriage to maintain the bucket in a vertical position during such change; substantially as described.

3. In blast furnace charging apparatus, an inclined trackway, a carriage movable thereon having an articulated frame, one portion of said frame being adapted to shift its angular position relative to the other portion thereof, and connections between the different portions of the frame and bucket arranged to shift the bucket to hold it in vertical position irrespective of the angular positions of the several portions of the frame; substantially as described.

4. In blast furnace charging apparatus, an inclined trackway leading to the top of the furnace, and having at its upper end an inwardly and downwardly curved guide portion, an articulated carriage movable on the track, a bucket suspended from the front portion of the carriage, and connections between the carriage portions arranged to seat and hold the bucket in vertical position when the rear carriage portion is on the straight portion of the track, substantially as described.

5. In blast furnace charging apparatus, an inclined track extending to the top of the furnace and having an inwardly and downwardly curved guide portion, a carriage movable on the track, and bucket-guiding mechanism mounted on the carriage and arranged to shift the bucket and guide it to its proper seating position as the carriage moves over the inwardly and downwardly curved portion of the track, substantially as described.

6. In blast furnace charging apparatus, an inclined track leading to the top of the furnace and having a curved upper portion, a bucket suspended from the carriage, and connections for moving the carriage, said carriage comprising an articulated structure having parallel motion connections, substantially as described.

7. In blast furnace charging apparatus, an inclined track leading to the top of the

furnace, a carriage movable thereon, a bucket having a central rod or support connected to the carriage, and mechanism on the carriage arranged to shift and guide the bucket to its seating position, substantially as described.

8. In blast furnace charging apparatus, an inclined track leading to the top of the furnace and having an inwardly and downwardly curved guide portion, a carriage movable on the track, a bucket having a supporting rod connected to the carriage, and mechanism on the carriage for acting through said rod to shift and guide the bucket to its seating position, substantially as described.

9. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, a bucket having a bell bottom with a rod or stem connected to the carriage and supporting the bucket and load, and parallel motion mechanism on the carriage arranged to seat and guide the bucket to seating position, substantially as described.

10. In blast furnace charging apparatus, an inclined track, a hoisting carriage movable thereon, and a counterweight system on the carriage arranged to slow down the carriage during the final part of the upward movement, substantially as described.

11. In blast furnace charging apparatus, an inclined track leading to the top of the furnace, and terminating in a downwardly curved guide portion, a carriage movable thereon, and a counterweight system arranged to oppose the downward movement of the charge as it moves to seating position, substantially as described.

12. In blast furnace charging apparatus, an inclined track having at its upper end a curved guide portion, a carriage movable thereon, and a counterweight connected to the front portion of the carriage and arranged to oppose the downward movement of this portion during the downward seating movement of the charge carrier, substantially as described.

13. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, and separate counterweight systems, one of said systems being arranged to oppose the downward seating movement of the charge carrier, substantially as described.

14. In blast furnace charging apparatus, an inclined trackway leading to the top of the furnace and having a downwardly curved guide portion thereat, an articulated carriage having a charge carrier supported from its front portion, and a counterweight connection leading to the front portion and arranged to resist or slow down the downward movement of the charge carrier, substantially as described.

15. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, and a plurality of counterweight systems for the carriage, one of said systems being arranged to slow down the final movement of the carriage in seating the charge carrier, substantially as described.

16. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, a charge carrier supported on the carriage, and turning mechanism on the carriage arranged to move into and out of actuating engagement with a stationary turning mechanism, substantially as described.

17. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, a charge carrier supported on the carriage, and turning mechanism on the carriage arranged to move into and out of actuating engagement with a stationary turning mechanism, said turning mechanism being yieldingly held in engagement, substantially as described.

18. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, a bucket suspended from the carriage, the bucket stem having a toothed wheel, and a relatively stationary rack with which the gear wheel comes into mesh at the charging position, substantially as described.

19. In blast furnace charging apparatus, an inclined track, a carriage movable thereon, a bucket suspended from the carriage, the bucket stem having a toothed wheel, and a relatively stationary rack with which the gear wheel comes into mesh at the charging position, said rack being yieldingly held in engagement with the gear wheel, substantially as described.

20. In a blast furnace charging apparatus, an inclined trackway leading to the top of the furnace, a carriage having a plurality of trucks provided with wheels arranged to move on the track, one of said trucks having a pivotal connection to permit it to move at an angle with relation to the other truck, a bucket connected to the first truck, and mechanism connected to the bucket support and the carriage arranged to hold the bucket in a vertical position irrespective of the movement of the trucks; substantially as described.

21. In a blast furnace charging apparatus, an inclined trackway leading to the top of the furnace, a carriage having a plurality of trucks provided with wheels arranged to move on the track, one of said trucks having a pivotal connection to permit it to move downwardly while the other moves upwardly, a bucket connected to the first truck, and mechanism connected to the bucket support and the carriage arranged to hold the bucket in a vertical position when the trucks are moving in different directions; substantially as described.

22. In a blast furnace charging apparatus, an inclined trackway leading to the top of the furnace, a carriage having three trucks, each of said trucks being provided with wheels arranged to move on the track, one of said trucks having a pivotal connection to permit it to move at an angle with relation to the other trucks, a bucket connected to the first truck, and mechanism connecting the first truck to the other trucks arranged to maintain the bucket in a vertical position irrespective of the position of the trucks; substantially as described.

In testimony whereof, I have hereunto set my hand.

JULIAN KENNEDY.

Witnesses:
L. McKITRICK,
H. W. RANO.