No. 871,477. PATENTED NOV. 19, 1907.

H. L. CHARLES.

METHOD OF FEEDING REVERBERATORY FURNACES.

APPLICATION FILED MAR. 26, 1907.

6 SHEETS—SHEET 1.

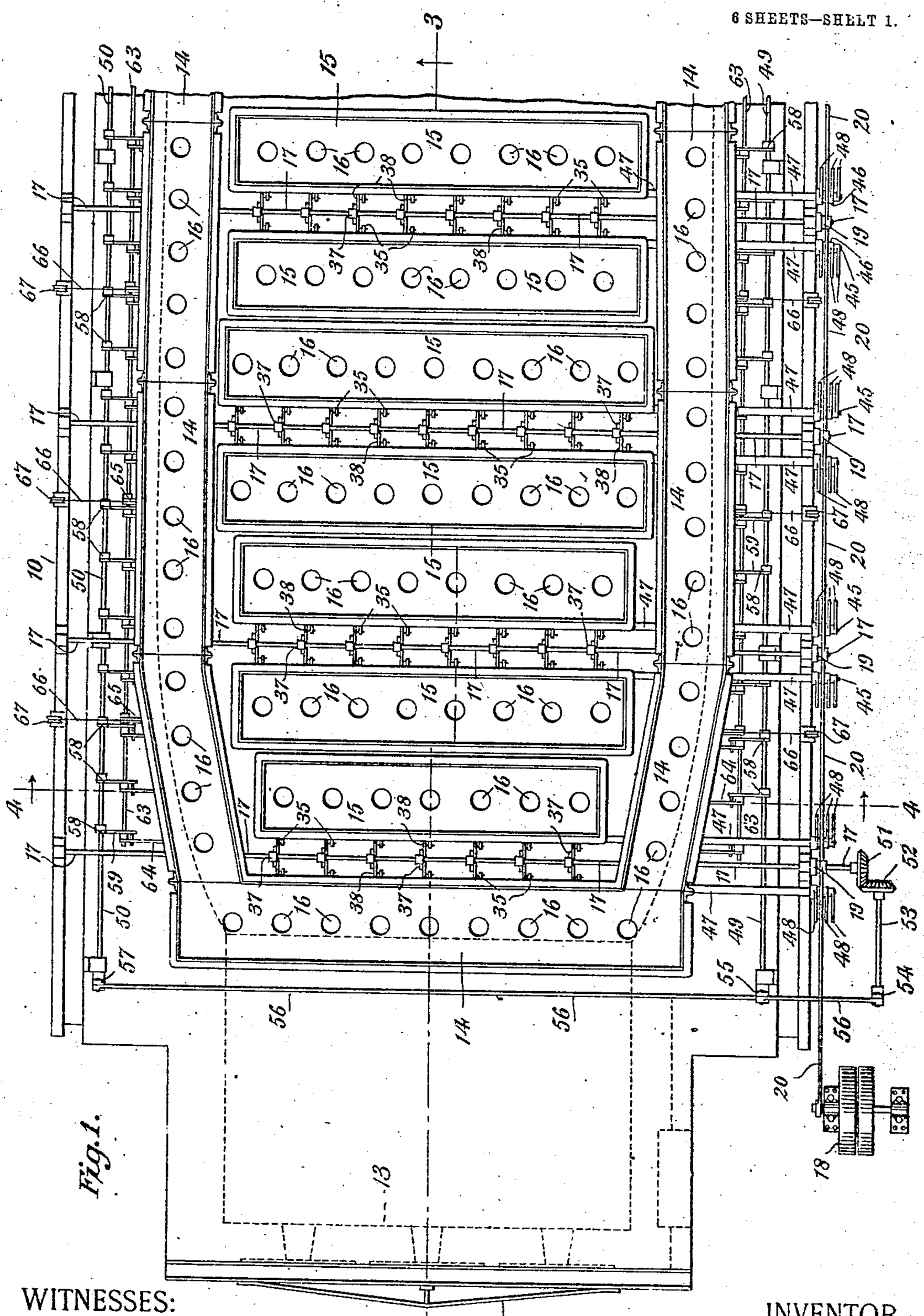

Fig. 1.

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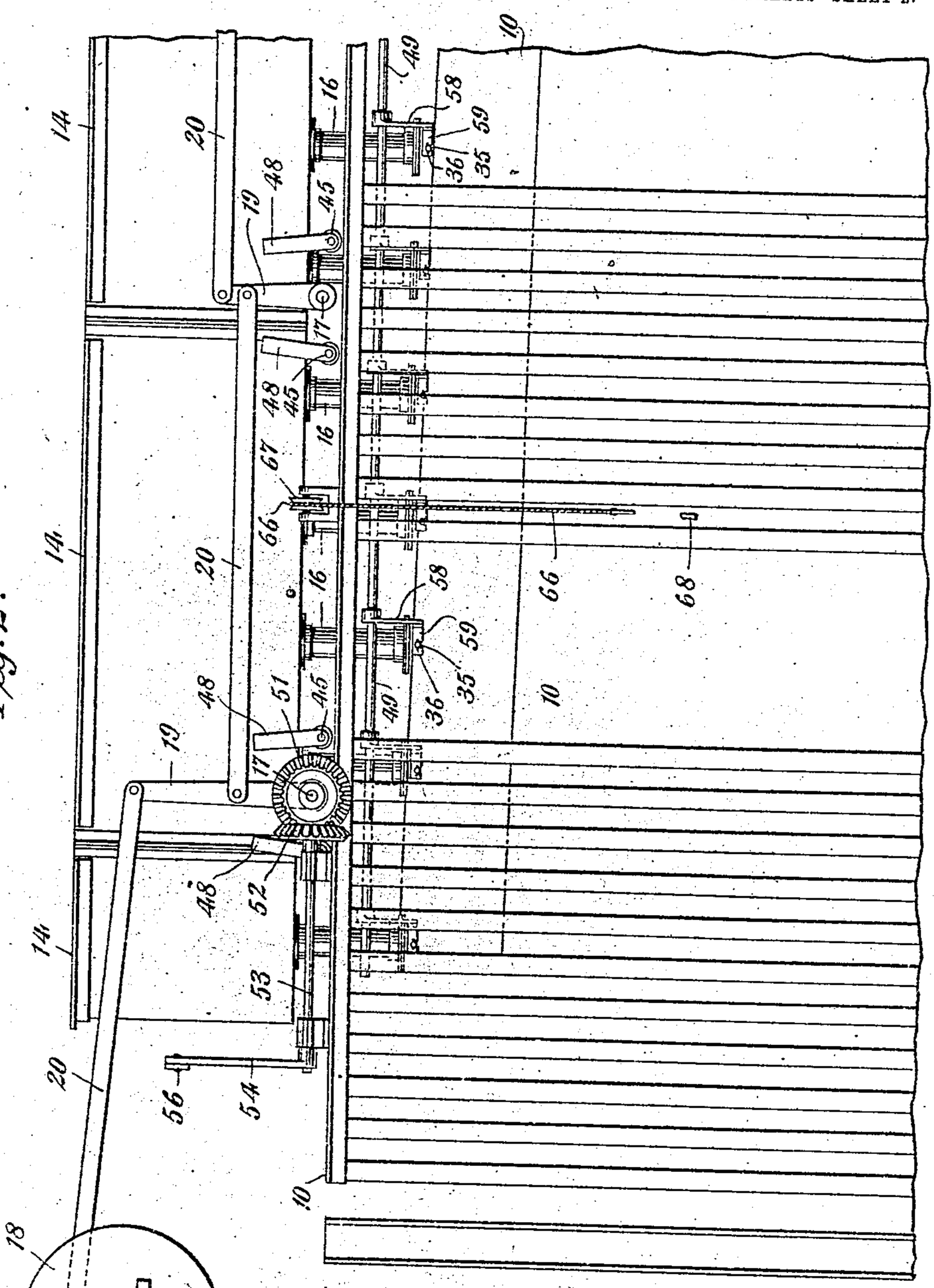
6 SHEETS—SHEET 2.

Fig. 2.



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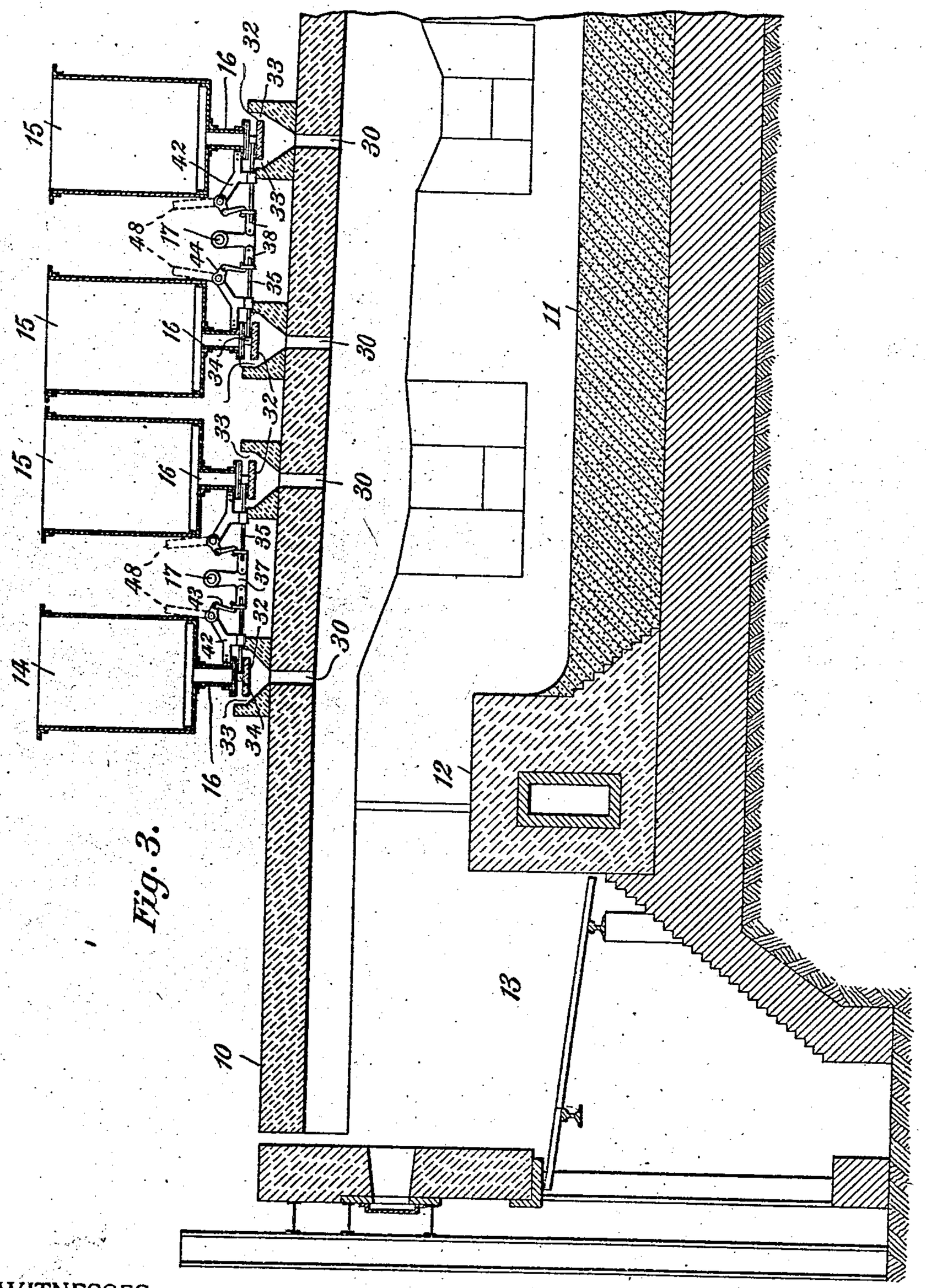

Fig. 3.

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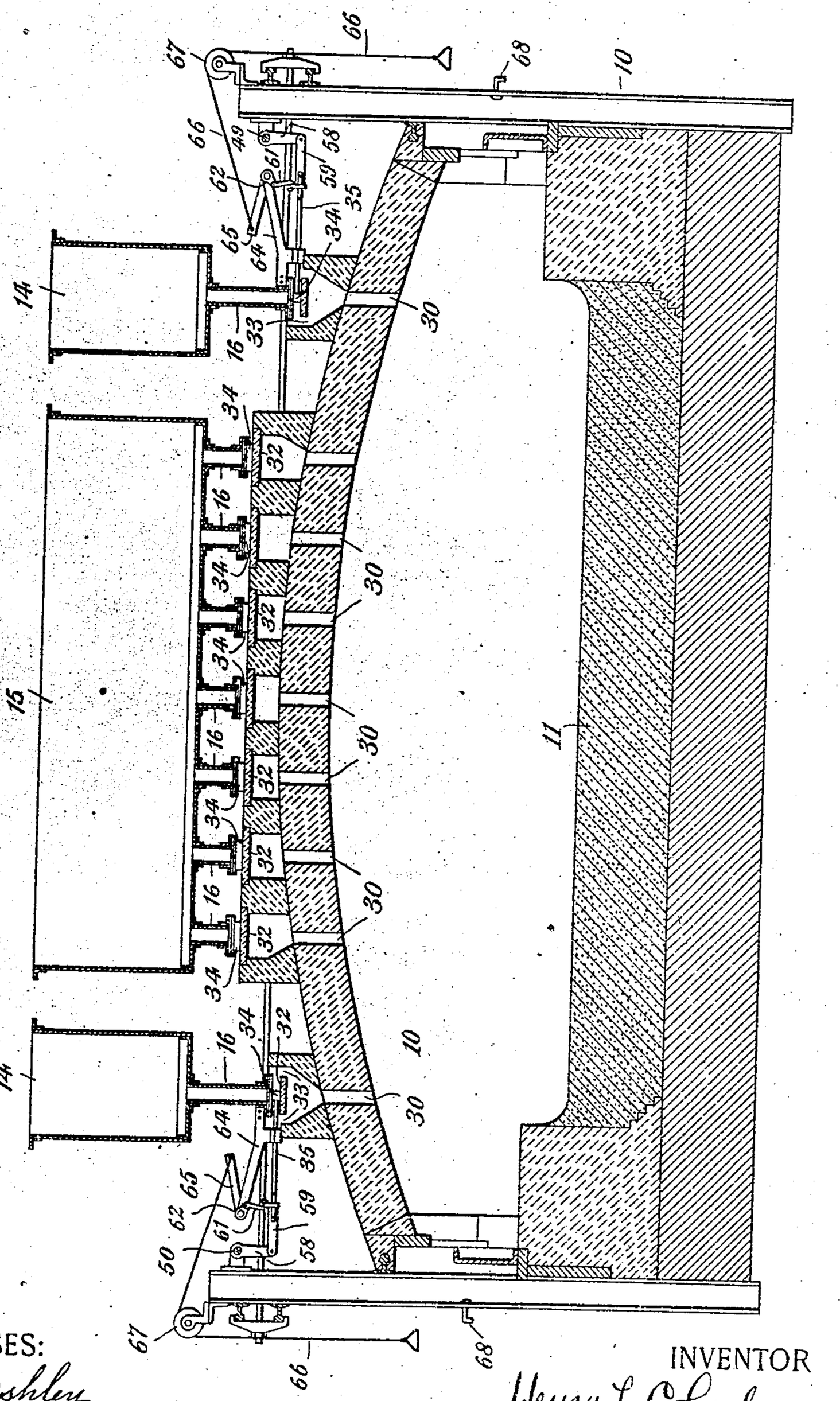

Fig. 4.

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6 SHEETS—SHEET 5

Fig. 5.

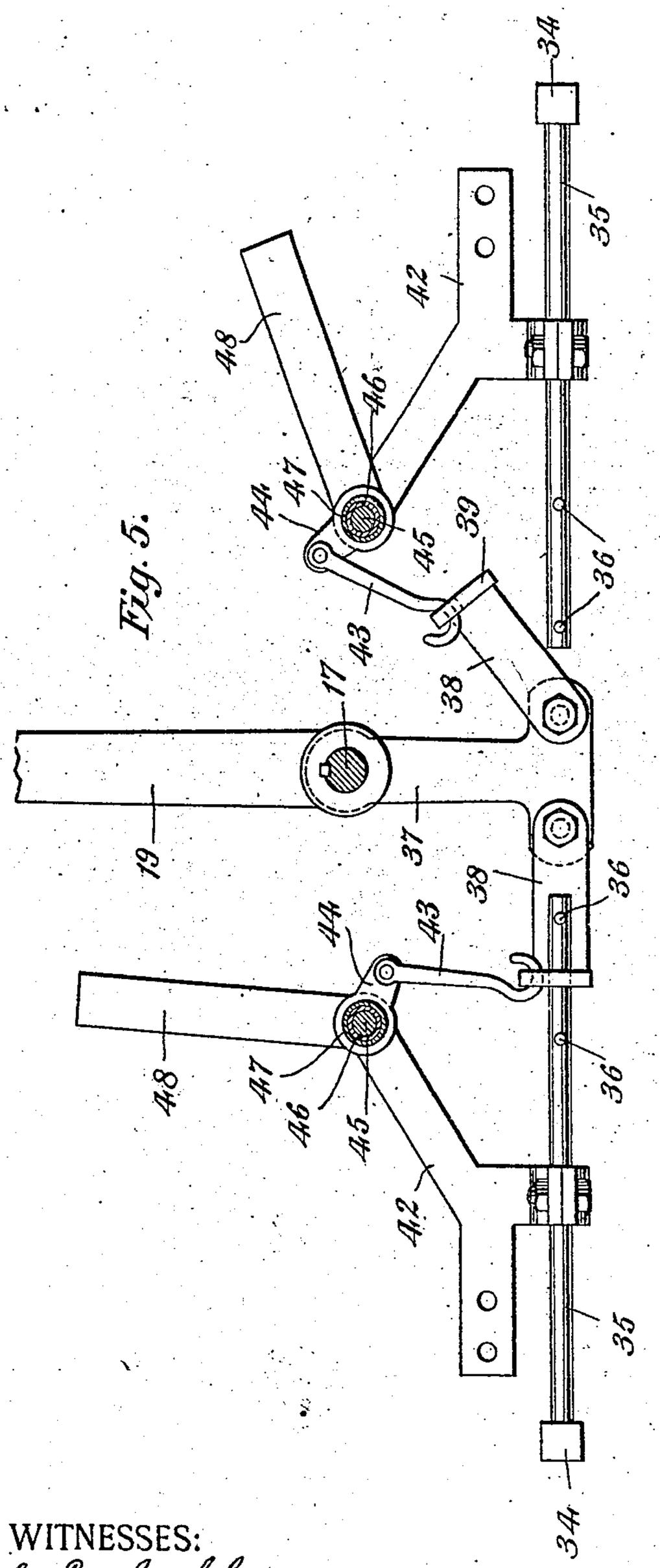
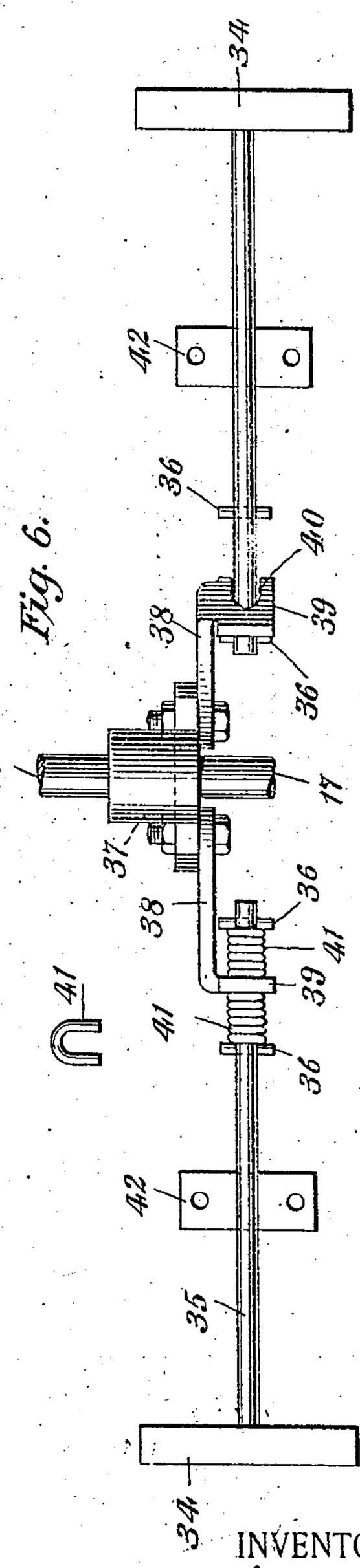


Fig. 6.



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6 SHEETS—SHEET 6.

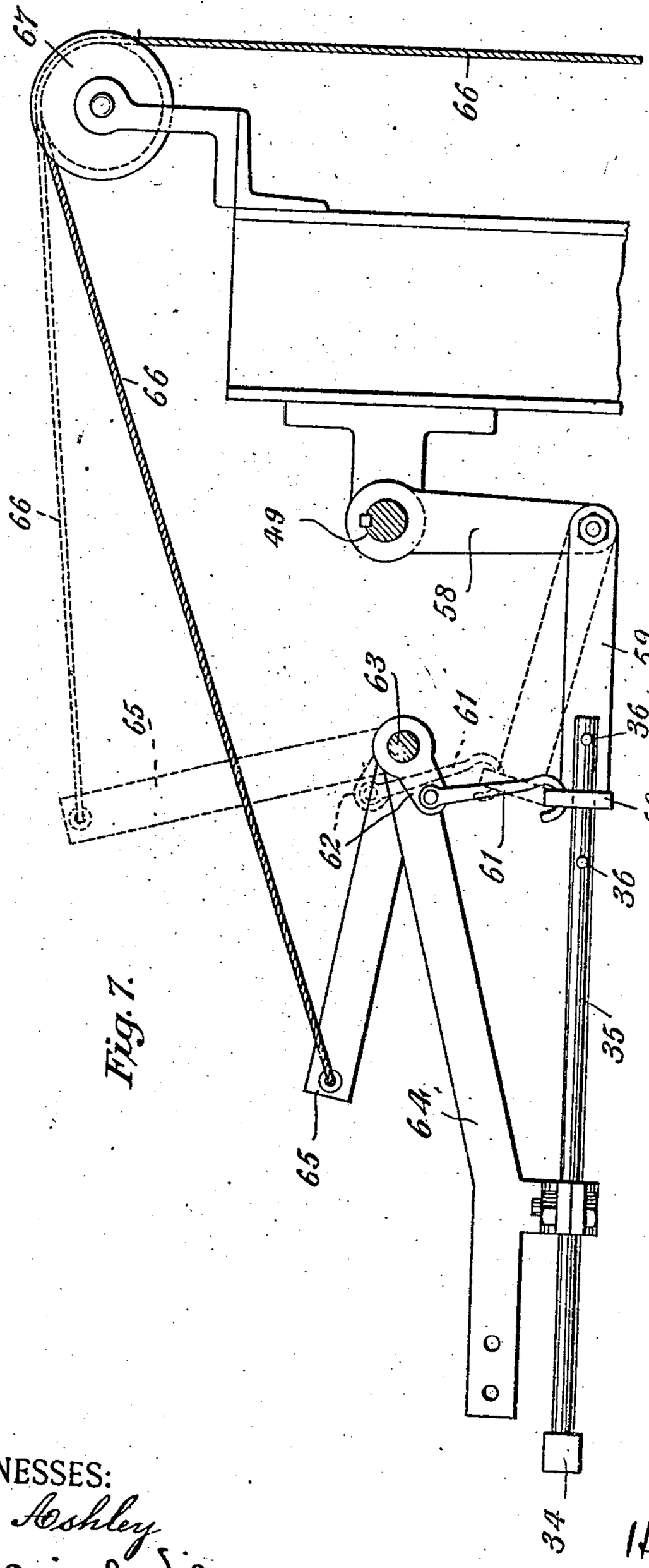

Fig. 7.

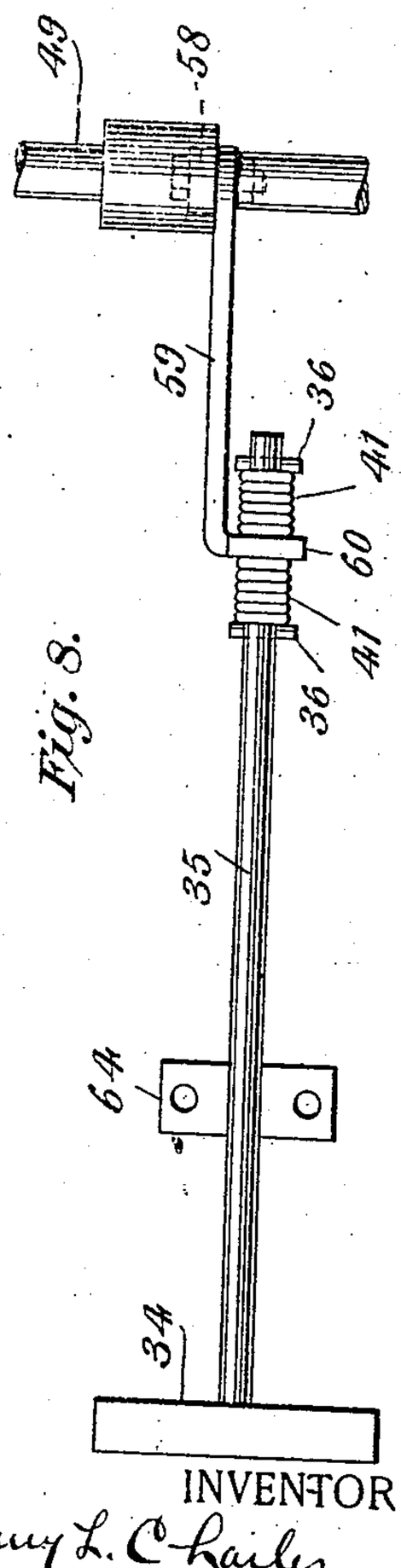

Fig. 8.

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Sanford Robinson

UNITED STATES PATENT OFFICE.

HENRY LEWIS CHARLES, OF SALT LAKE CITY, UTAH, ASSIGNOR OF ONE-HALF TO FRITZ AUGUSTUS HEINZE, OF BUTTE, MONTANA.

METHOD OF FEEDING REVERBERATORY FURNACES.

No. 871,477. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed March 26, 1907. Se ial No. 364,580.

To all whom it may concern:

Be it known that I, HENRY LEWIS CHARLES, a citizen of the United States of America, residing at Salt Lake City, county of Salt Lake, and State of Utah, have invented certain new and useful Improvements in Methods of Feeding Reverberatory Furnaces, of which the following is a specification.

My invention relates to an improvement in method of feeding reverberatory smelting furnaces and is intended to provide a means for increasing the capacity of a furnace with a saving of labor and fuel and at the same time preserving the furnace from corrosion. This I accomplish by an improved method or system of feeding the charges into the furnace.

Up to the present time it has been the universal practice to put an amount of charge into the furnace sufficient to cover the hearth over several inches deep. This is dropped in one charge at or near the center of the hearth through large slots or drop holes provided in the roof of the furnace. The doors are then opened and the charge leveled with rabbles. This takes several hours to smelt before another charge can be received as the temperature is reduced from 2500° F. to less than 1000° F. It is also the practice to tap out all of the molten slag and matte in order to fettle the walls on the inside of the hearth where corrosion takes place, owing to the molten bath coming in contact with the brick lining. This is required at intervals of from one to ten days and entails great loss of time, heat and material, as it is usually done with barren silica (SiO_2). Another great detriment caused by tapping out is that it allows the fresh iron sulfids (FeS) to come in contact with the silica in the bottom of the hearth and corrode it each time, with the result that in a few months it is worn so thin that it must be renewed.

I have discovered first that by feeding the raw silicious ores close to the side walls of the furnace thereby preventing the molten slag, matte or any of the sulfids from touching the brick lining corrosion of the wall around the hearth can be prevented, the life of the furnace prolonged, labor and material saved and an increased tonnage obtained as the molten bath will attack these silicious ores instead of the furnace walls. Secondly that by reducing the size of the charges and feeding them in oftener and at various places over the hearth with the furnace kept at full heat all the time, the tonnage will be compounded several times and a saving of labor in feeding, leveling, charges and fettling will be accomplished and a saving of heat, as the present large charges bring the furnace below the smelting temperature whereas, under my system, a continuous operation results.

My invention will be best understood by reference to the accompanying six sheets of drawings which fully illustrate my invention, representing more or less diagrammatically part of a reverberatory furnace. The flue end, which is of ordinary and well known construction, has been omitted.

In the drawings Figure 1 is a plan view of the top of the hearth and center of a furnace, showing my invention, particularly the position of the trough-like hoppers. Fig. 2 is an elevation of the lower side of Fig. 1. Fig. 3 is a longitudinal section taken on the line 3—3. Fig. 1. Fig. 4 is a cross section taken on the line 4—4 Fig. 1. Figs. 5, 6, 7, & 8, illustrate on an enlarged scale my devices for feeding small quantities of ores from the hoppers onto the furnace bed.

Referring to Figs. 1, 2 & 3, the furnace —10— is provided with a hearth —11— bridge —12— over which pass the gases from the fire box —13— finally escaping from the flue at the opposite end (not shown). This part of the furnace may be of any desired construction.

My invention consists in a practically continuous feeding of ores to the furnace, through dropping very small charges at frequent intervals, or continuously, at various places, over the hearth without interrupting the smelting or reducing the temperature. I propose to feed silicious material or ores through a series of small holes in the roof located near the edge of the hearth, so that such material will pile against the furnace walls and protect them from corrosive action. The raw or calcined ores I propose to feed through a series of small holes, located over the remaining portion of the hearth. This I accomplish in the following manner. The silica or silicious material to be used for fettling will be fed from a continuous hopper or trough —14— extending around the edge of the furnace —10—. These ores will fall close to the side walls of the furnace —10—

making a dam or base sloping towards the hearth —11— preventing the molten slag, matte, or any of the sulfids from touching the brick lining thereby avoiding all corrosion around the hearth —11—. The raw or calcined ores will be fed into the furnace —10— from a series of transverse hoppers or troughs —15—. This arrangement of the various hoppers, continuous and transverse is clearly illustrated in Fig. 1 also the openings of the drop pipes —16— through which the ores are fed onto the hearth —11—. The hoppers —14 and 15— and drop pipes —16— are shown in elevation in Figs. 2, 3 & 4.

The operation of feeding the ores onto the hearth of the furnace in varying quantities as required, is as follows: The transverse hoppers —15— are arranged in pairs, and between each pair a shaft —17— extends across the furnace —10—. The shafts —17— have a rocking motion transmitted from an eccentric on the head motion —18— and are connected by a series of levers —19— and links —20. By this arrangement the shafts —17— all have the same motion. The small drop holes —30— in the roof or main arch —31— of the furnace —10— are partially covered by fire brick slabs —32— having openings —33— on opposite sides. Plungers —34— rest on the slabs —32— and slide, back or forth, feeding more or less ores through the openings 33 and holes 30 onto the hearth —11— by means of the rocking motion transmitted through the shafts 17. The plungers —34— are provided with rods —35— and stop pins —36—. Suspended from and keyed to the shafts —17— are arms —37— one for each feeder. Connected to arms —37— are swinging arms —38— with projections —39— at their outer ends. These projections —39— have slots —40— and drop over the plunger rods —35— between the stop pins —36—. It is evident that when the projection —39— reaches either of the stop pins —36— on the plunger rod —35— any further motion will be transmitted to the rod —35— and plunger —34. The amount of travel of the plungers —34— is regulated by inserting or removing filling pieces —41— shown on left hand side of Figs. 6 & 8. When all the pieces —41— are in place, the movement of plunger —34— will be greatest and as they are removed, the effective movement of the plunger —34— is decreased. The ore drops on each side of the plunger —34— as it rests on the fire brick slab —32— and the sliding movement of the plunger 34, back and forth, shoves the ore off the slab 32 and into the furnace —10—. Brackets —42— are riveted to the drop pipes 16— and support the plunger rods 35.

In order to stop two or three feeding plungers without interrupting any of the others, the following arrangement is provided and is illustrated in Figs. 5, 6, 7 & 8. The swinging arms —38— are supported by hooks —43— pivoted to dogs —44— which are attached to a shaft supported in the bracket —42. This shaft is made up of a center shaft —45— and two sleeves or pipes —46— and 47 Fig. 5. Each of these shafts is capable of individual rotation by handles —48— on the outside of furnace —10— and has three or more dogs —44— attached. By turning down a handle —48— the shaft —47— is partially rotated, thus raising dogs —44— and hooks —43. The hooks —43— elevate the swinging arms 38 with projections —39— and slots —40—, clear of the plunger rod 35 and pins —36— and all movement of the plunger —34— ceases. See right hand side of Fig. 5. The above arrangement could be changed so that each feeder could be stopped or started independently of all the rest, but this would require more handles and pipes. The silicious ores are fed from hoppers —14— in much the same manner, Figs. 7 & 8.

Along each side of the furnace —10— is a rocking shaft —49— and 50— which is operated from the eccentric on the head motion —18— as follows: The rocking shaft —17— nearest the fire box —13— carries a bevel gear —50— engaging with a bevel gear —52— on a shaft —53—. This shaft also carries a lever —54— connected to a lever —55— on shaft —49— by means of a link —56—. Thus a rocking motion is conveyed to shaft —49. Lever —55— link —56— and lever —57— on shaft, 50, convey this rocking motion to shaft —50— on opposite side of furnace —10— Fig. 1. There are hangers —58— keyed to shafts —49— and —50—, one for each feeder. Pivoted to the lower end of each hanger —58— is an arm —59— with a slotted projection —50— which is raised out of contact with the plunger rod 35 and stop pins 36— by means of hooks —61— pivoted to dogs —62— attached to short shafts —63— mounted in brackets —64—. The shaft —63— carries a counterweight arm —65— to which a rope —66— is attached. This rope passes over a pulley —67—. The weighted arm —65— keeps the dogs —62— in lower position when feeders are in operation, but when a set are to be stopped, the rope —66— is pulled down and hooked over a pin —68—. This is plainly illustrated in Figs. 7 & 8. In this manner a molten bath of from fifty to one hundred tons of matte and slag, by only feeding in at various points small quantities at one time, can be kept at full heat and the amounts fed in will scarcely touch the molten bath before they become liquid themselves. I have dropped 650 pounds per second by hand for hours at a time into a furnace to demonstrate my idea, and have reached a capacity of 500 tons smelted per 24 hours on a furnace that was

smelting 150 tons per 24 hours on a 12-ton charge.

Under my method also the arch is stronger with the small perforations than with the one large opening and it is not necessary to open the doors of the furnace in order to level the charge with rabbles with a consequent loss of heat as under the present system.

I claim as my invention

1. The within described method of feeding ores into reverberatory furnaces consisting in dropping the same over the hearth in small charges at frequent intervals.

2. The within described method of feeding ores into reverberatory furnaces consisting in dropping the same over the hearth in small charges at frequent intervals and at various places.

3. The within described method of feeding ore into reverberatory furnaces consisting in dropping the same onto the hearth through a series of small holes located in the roof of the furnace.

4. The within described method of feeding ores into reverberatory furnaces consisting in feeding raw silicious ores between the calcined ores and the edges of the hearth.

5. The within described method of feeding ores into reverberatory furnaces consisting in dropping raw silicious ores around the edges of the hearth and the calcined ores in small quantities over the inner portion of the hearth.

6. The within described method of feeding ores into reverberatory furnaces consisting in dropping raw silicious ores onto the hearth through small holes located in the arch of the hearth near the edges of the hearth and dropping calcined or roasted ores in small charges over the inner portion of the hearth through small holes located in the arch of hearth.

7. The within described method of feeding reverberatory furnaces consisting in feeding silica or silicious material for fettling continuously from a hopper or trough extending around the edge of the hearth and in feeding the ore in small charges over the hearth of the furnace by any convenient means.

8. The within described method of feeding ores into a reverberatory furnace, consisting of dropping the same through numerous small openings in the roof of the furnace in a continuous or intermittent stream, in such minute quantities that the individual particles will be smelted before reaching the molten bath.

9. The within described method of feeding ores into reverberatory furnaces, consisting of feeding the same in in one or more rain-like streams whereby the ore is smelted immediately without reducing the furnace temperature.

10. The within described method of feeding ores into reverberatory furnaces, consisting of feeding the same over the hearth in small quantities and at frequent intervals by any convenient means.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 5th day of March 1907.

HENRY LEWIS CHARLES.

Witnesses:

IMOR PETT,

A. E. HADLEY.