No. 755,947. PATENTED MAR. 29, 1904.

J. SHENEMAN.

CEMENT FURNACE.

APPLICATION FILED JAN. 5, 1904.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.

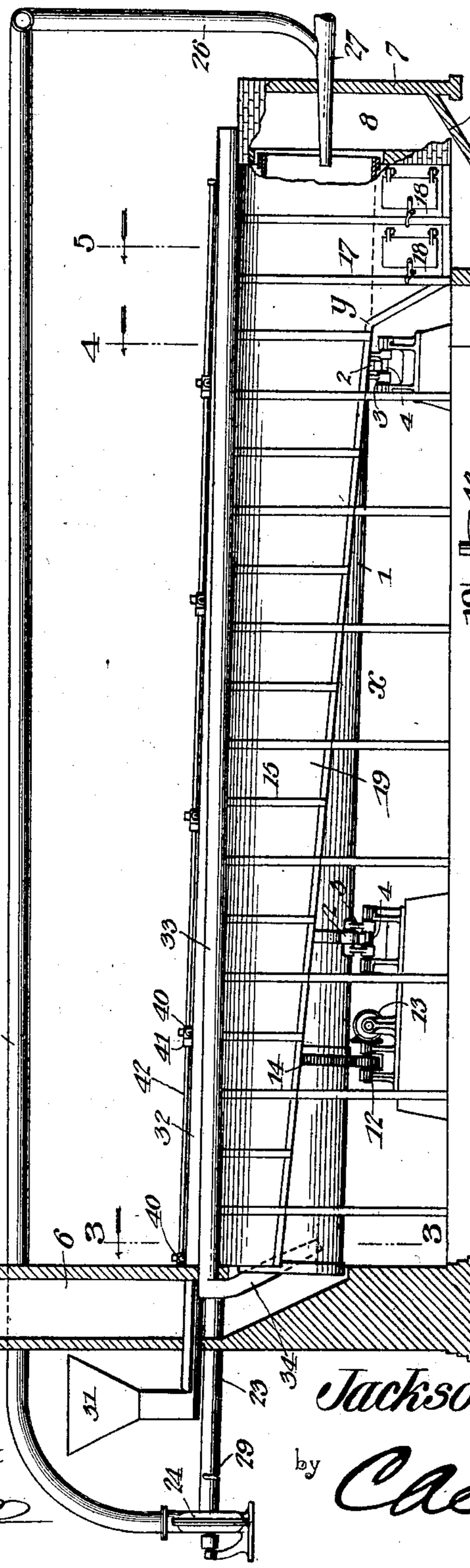


Fig. 9.

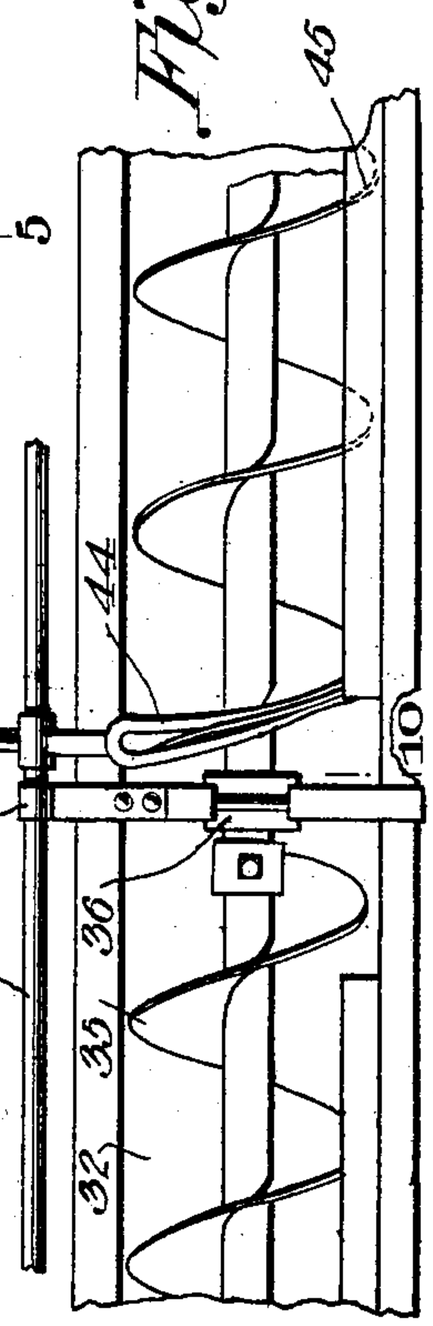
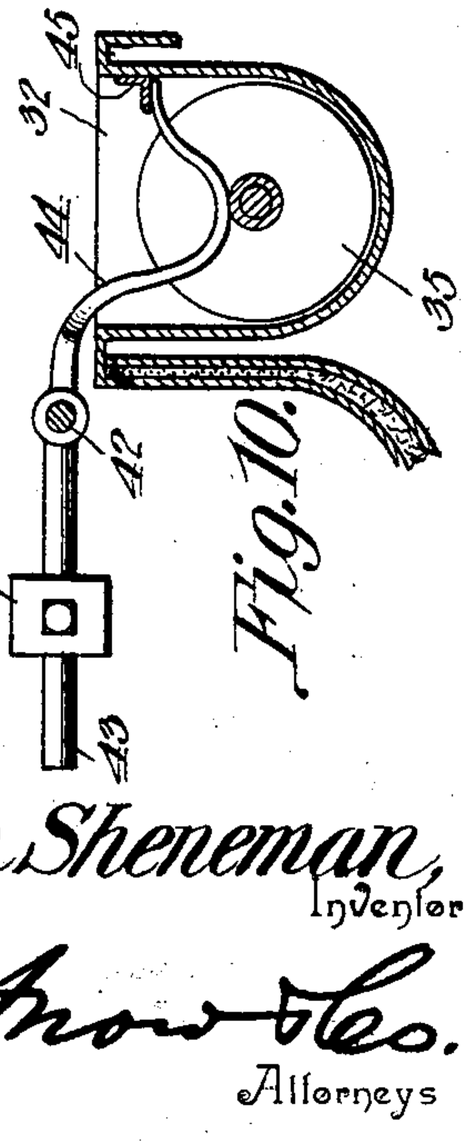


Fig. 10.



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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 6.

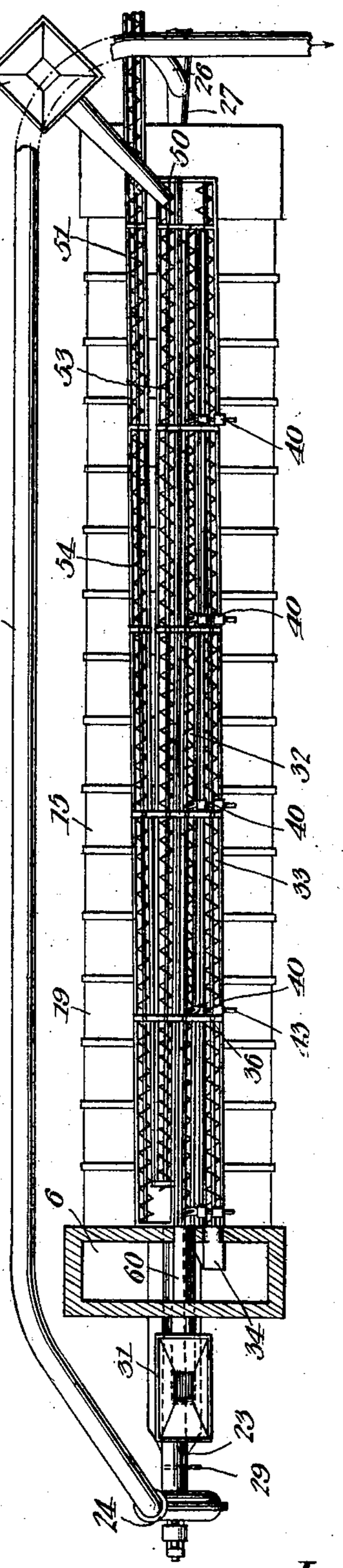
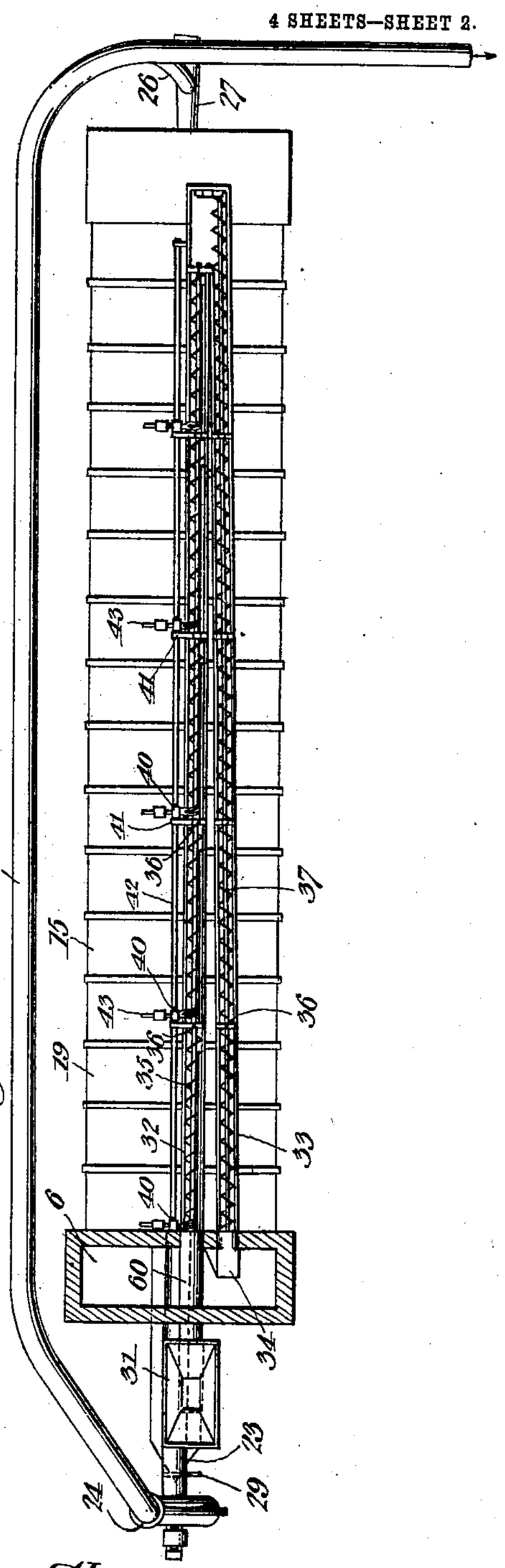


Fig. 2.



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 3.

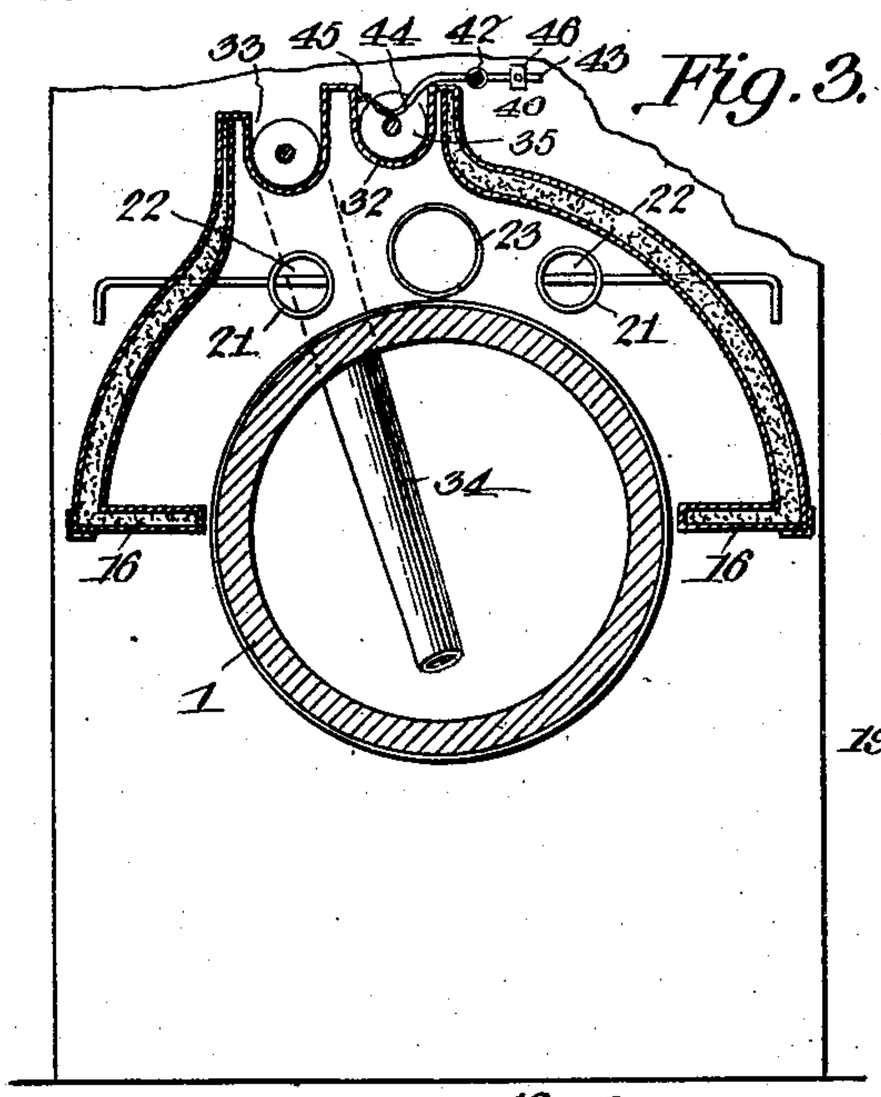


Fig. 4.

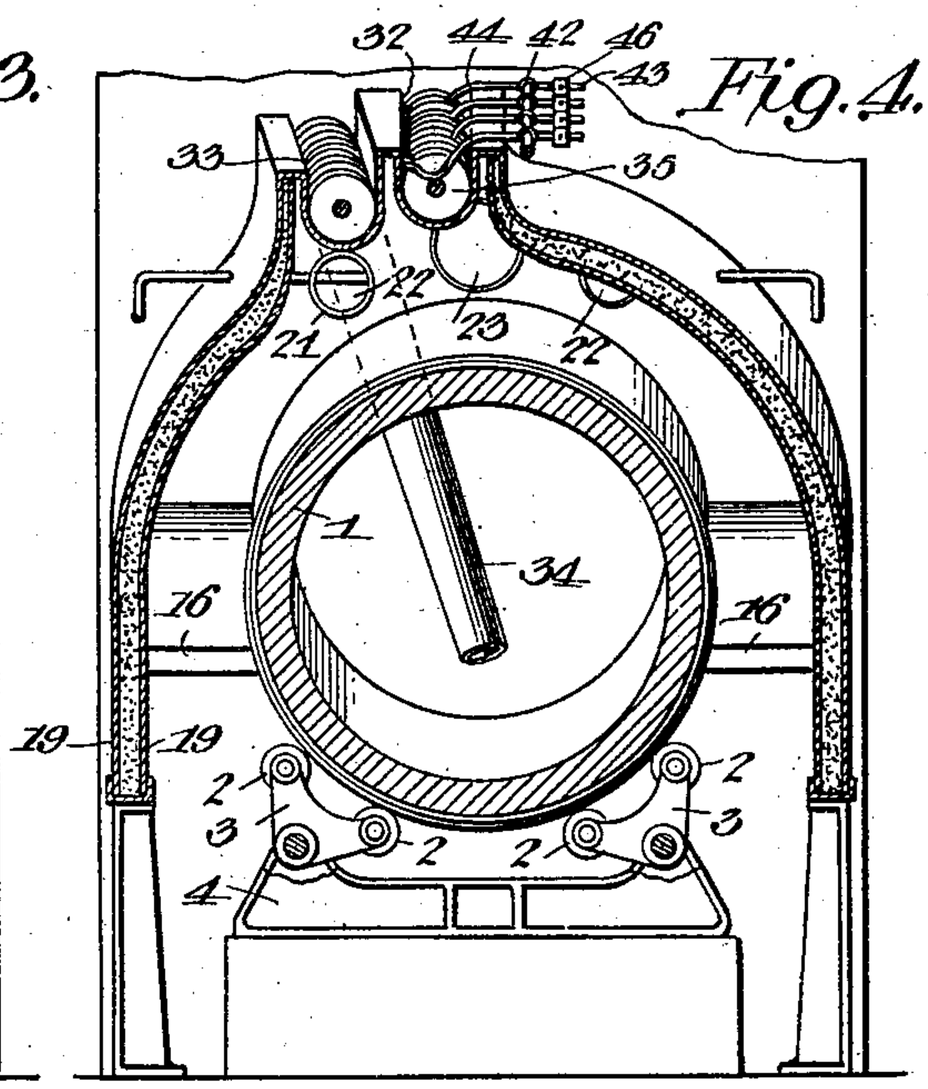


Fig. 5.

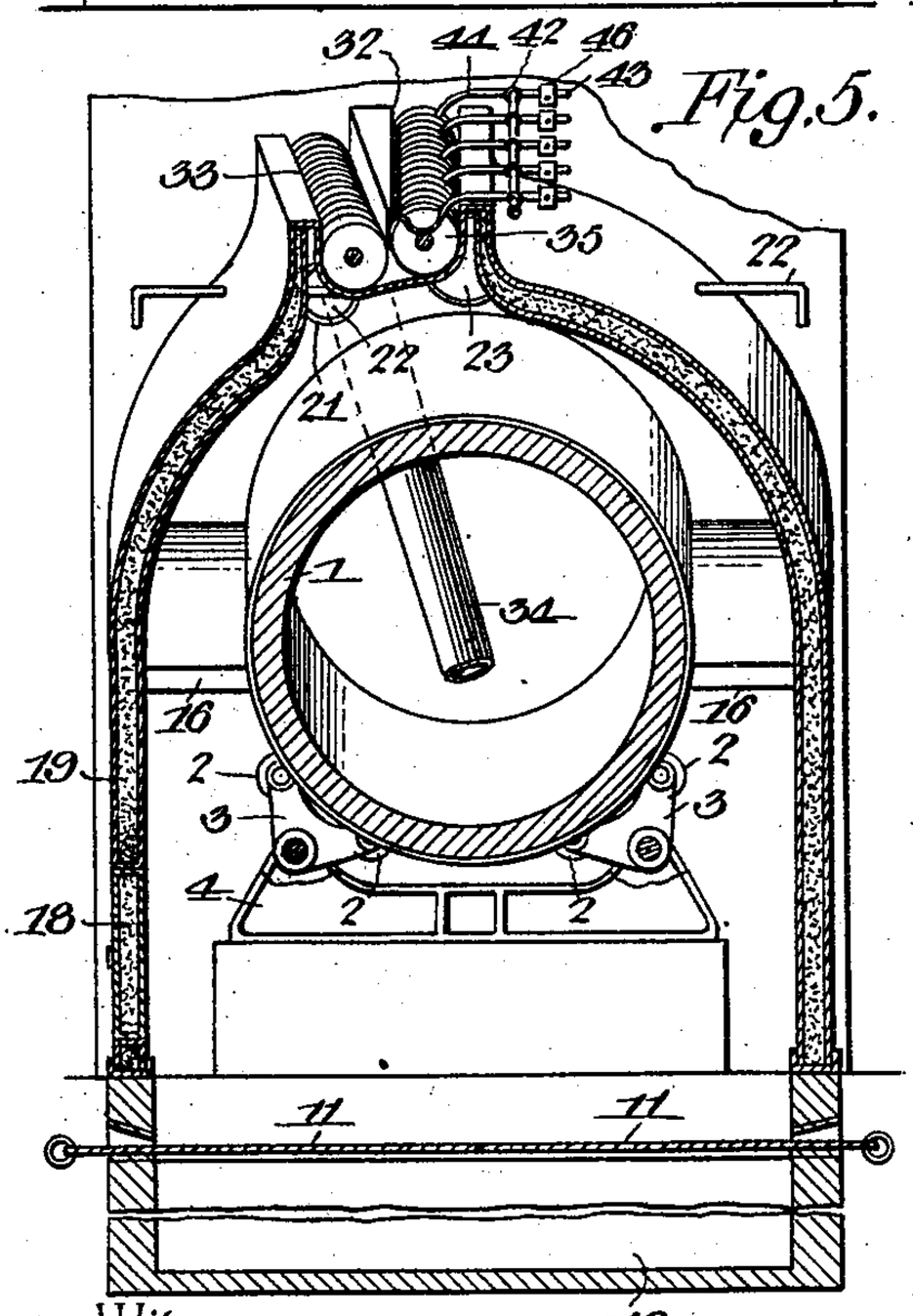
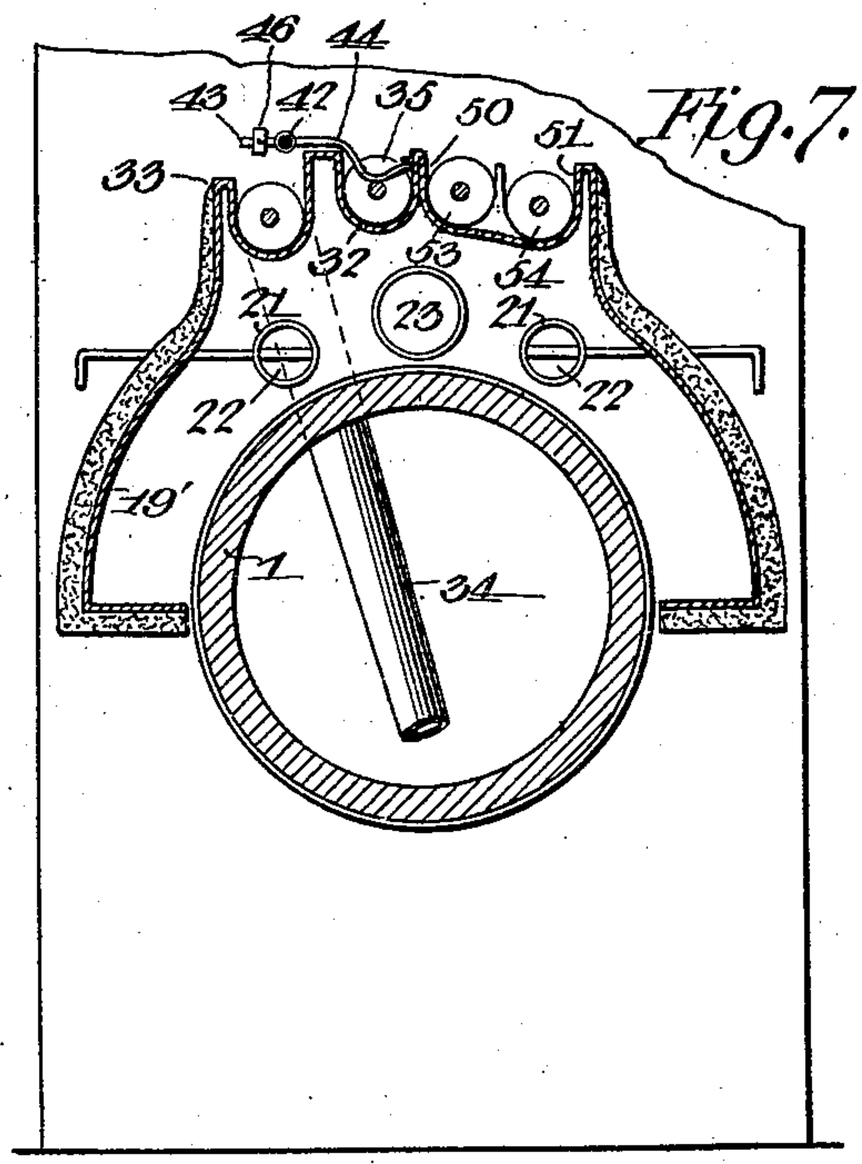


Fig. 7.



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Witnesses

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No. 755,947. PATENTED MAR. 29, 1904.

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CEMENT FURNACE.

APPLICATION FILED JAN. 5, 1904.

NO MODEL. 4 SHEETS—SHEET 4.

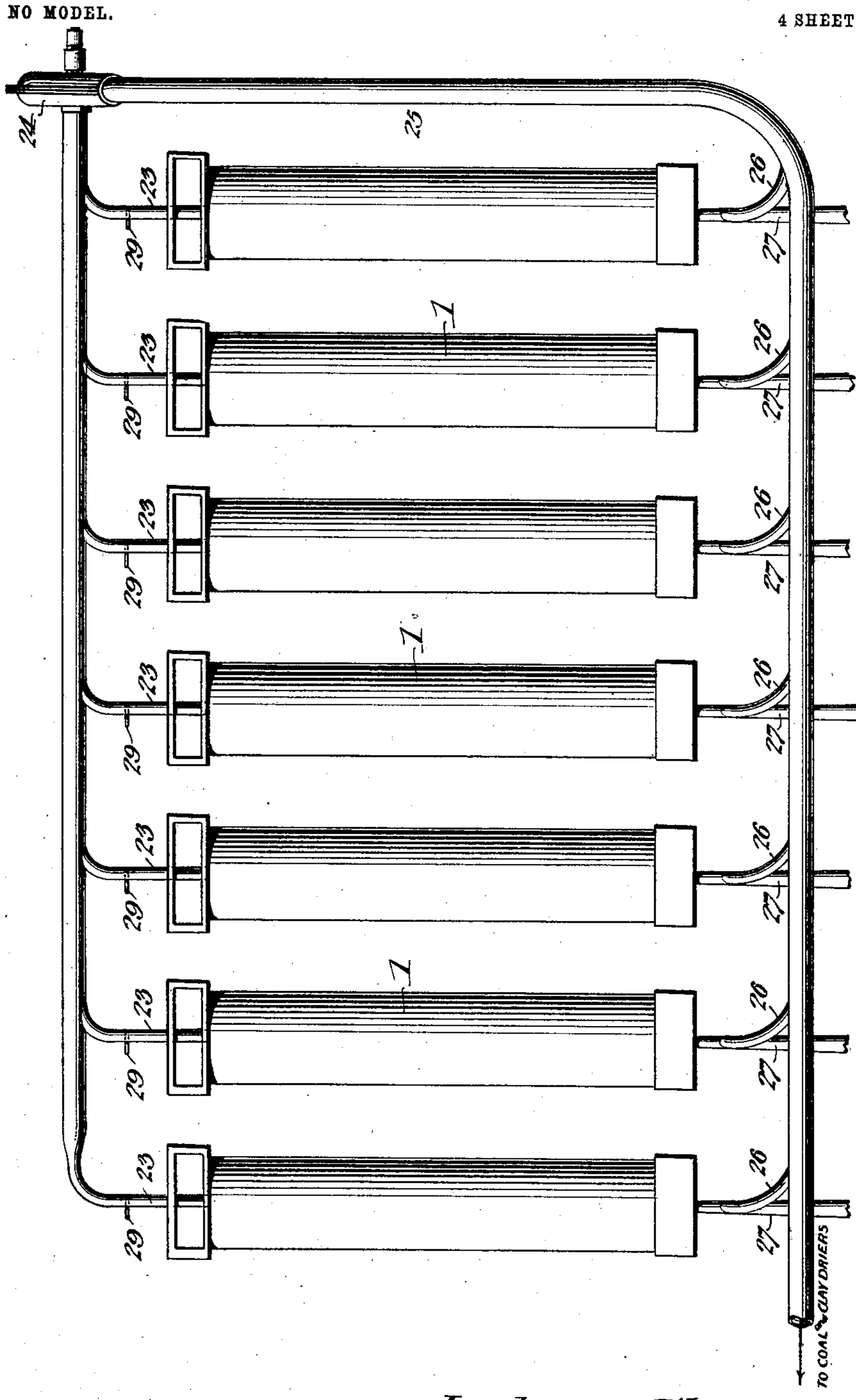

Fig. 8.

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No. 755,947. Patented March 29, 1904.

UNITED STATES PATENT OFFICE.

JACKSON SHENEMAN, OF BRONSON, MICHIGAN.

CEMENT-FURNACE.

SPECIFICATION forming part of Letters Patent No. 755,947, dated March 29, 1904.

Application filed January 5, 1904. Serial No. 187,821. (No model.)

To all whom it may concern:

Be it known that I, JACKSON SHENEMAN, a citizen of the United States, residing at Bronson, in the county of Branch and State of Michigan, have invented a new and useful Cement-Furnace, of which the following is a specification.

This invention relates to improvements in apparatus for the manufacture of cement, and particularly to devices employed for calcining marl, clay, and the various argillaceous limestones used in the manufacture of Portland cement.

The principal object of the invention is to utilize the waste heat from the kiln for the purpose of effecting preliminary drying of the marl, slurry, clay, or coal or any other material used during the process of manufacture.

A further object of the invention is to utilize the surplus heat from the outside of a rotary kiln in such manner as to dry the cement-forming materials in advance of their entrance to the kiln and, further, to utilize the heat in some cases for the drying of the fuel employed.

A still further object of the invention is to utilize the heated air under pressure as a means for injecting powdered fuel into the kiln.

A still further object of the invention is to utilize both the waste heat from the kiln and the waste heat and gases from the clinker or dried material discharged from the kiln in the drying of the marl and other cement-forming materials.

A still further object of the invention is to provide a kiln structure in which the heat from the fuel will be fully utilized and the burning out of the walls of the kiln prevented.

A still further object of the invention is to provide an economical means for utilizing the waste heat from a battery of kilns and to provide for the control of the air-currents, so that the air from unused kilns may be cut off in order to prevent the reduction of temperature of the heated air from kilns in operation.

With these and other objects in view, as will hereinafter more fully appear, the invention consists in the novel construction and arrangement of parts hereinafter described, illustated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size, and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings, Figure 1 is a side elevation, partly in section, of a cement-furnace constructed in accordance with the invention. Fig. 2 is a plan view of the same. Figs. 3, 4, and 5 are transverse sectional elevations of the furnace on the lines 3 3, 4 4, and 5 5, respectively, of Fig. 1. Fig. 6 is a view similar to Fig. 2, illustrating a slight modification of the invention. Fig. 7 is a transverse sectional elevation of the same on the line 7 7 of Fig. 6. Fig. 8 is a plan view, partly in the nature of a diagram, showing a battery of furnaces arranged and connected in accordance with the invention. Fig. 9 is a plan view, drawn to an enlarged scale, of a portion of one of the screw conveyers, showing the conveyer-cleaner. Fig. 10 is a transverse sectional elevation of the same on the line 10 10 of Fig. 9.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The kiln proper consists of a metallic cylinder 1, open at both ends and having an inner lining of fire-brick or similar material. The cylinder is supported at a slight angle to the horizontal by means of small rollers 2, mounted in pairs on swinging brackets 3, that are pivotally mounted on transverse bars 4, carried by the foundation or bed of the apparatus, the brackets and rollers being practically self-adjusting, so as to form supports which will permit the cylinder to readily revolve without undue friction. The rear end of the cylinder communicates with a flue or stack 6 for the escape of the products of combustion, and the front end of the said cylinder is partly inclosed by a wall 7, forming a chamber 8, into which the clinker or calcined material is discharged and is thence directed by an inclined partition 9 to a suitable pit 10, from whence it may be conducted by endless conveyers to a grinding apparatus of any

suitable construction. Above the pit is a slidable cut-off 11, which may be moved to close the entrace to the pit when necessary.

The cylindrical kiln is revolved by any suitable mechanism—as, for instance, by a pinion 12, driven by suitable gearing connections 13 and intermeshing with an annular rack 14 encircling the cylinder.

Extending from the upper portion of the cylindrical kiln is a jacket 15, which for the most part is semicircular in form, so that it covers only the upper portion of the cylinder, and from the point *x* about midway of the length of the cylinder to the rear end thereof the jacket is provided with inturned flanges 16, which extend to the periphery of the cylinder in order to prevent the entrance of air between the jacket and the cylinder. That portion of the jacket at the front end of the cylinder is in part formed by the wall 7 and the side walls 17, which are extended down to the base-line of the structure and extend rearwardly to the rear wall of the clinker-pit. The side walls then extend up at an angle to the vertical and connect with the lower walls of the substantially semicircular portion of the jacket at about the point *y*. The side walls 17 are provided with suitable doors 18, which may be opened to a greater or less extent to permit the entrance of air to the jacket or may be opened wide in order to permit cleaning or to gain access to the clinker-pit when necessary. From the point *x* to the point *y* the lower edges of the jacket are spaced from the revoluble kiln in order to permit the free entrance of air to said jacket, and, as before described, from the point *x* to the rear end of the cylinder the jacket is provided with the inclosing flanges 16.

The jacket is preferably formed of sheet metal and in the form illustrated in Figs. 3, 4, and 5 comprises a pair of spaced plates 19, between which is inserted asbestos, mineral wool, or similar material, or a single sheet of metal may be used, as indicated at 19′ in Fig. 7, and this single sheet can be covered with similar material, if desired.

At the rear end of the jacket are arranged one or more escape-flues 21, by which the jacket may be placed in communication with the escape-flue 6, and the flues 21 are provided with dampers 22, by means of which the passage of the heated air from the jacket to the main flue or stack may be controlled.

From the rear end of the jacket leads a tube or tubes 23 to a fan 24, by means of which the hot air is drawn from the jacket and forced through a pipe 25 to any desired point. A portion or all of this air is conducted by a branch pipe 26 to an injector 27, through which powdered or other fuel is forced into the front end of the revoluble kiln, and this fuel is preferably in the form of powdered coal which, combined with the air, will produce the intense heat necessary in the calcining operation, the products of combustion after passing through the kiln escaping to the main flue or stack 6. In some cases, especially where a battery of kilns is employed, it will be necessary to use only a single fan for operating all of the kilns, such a construction being shown in Fig. 8, and inasmuch as each of the tubes 23 leading from the kiln is provided with a damper 29 the air from the jackets of unused kilns may be cut off in order to prevent the fan from drawing cold air therethrough. In all cases the blast-pipe leading from the kiln may be led, as by a pipe 30, to drying devices for preliminary treatment of coal, clay, or other material with a view of fully economizing the quantity of fuel.

The marl and other cement-forming material to be dried and calcined is deposited in a hopper 31, from which leads a conveyer-trough 32, extending over or forming a part of the top of the jacket, preferably for the full length thereof, and at the front end of the trough is connected a second or return trough 33, which leads also over or forms part of the top of the jacket and is connected to a spout 34, leading to the rear end of the kiln and through which the contents of the trough are discharged into said cylinder. In the first trough 32 is a screw conveyer 35, that is preferably formed of a number of sections in order to permit the introduction of bearings 36 at convenient intervals, and in the trough 33 is a conveyer 37, which may be of similar construction. It will be noted that the two troughs are arranged on lines that converge at a point adjacent to the front end of the kiln, and, as shown in Fig. 5, the trough 32 is disposed in a horizontal plane slightly above the returning trough 33, so that material conveyed to the front end of trough 32 will move under the influence of gravity to the return-trough 33 and will then be caught by the conveyer 37 and returned to the discharge-spout 34. It will be observed that the troughs are arranged at different angles with respect to the curved surface of the jacket, so that both troughs will be subjected to the action of the heat for their entire length, while the gravitational discharge from the upper to the lower trough will be due to the fact that the trough nearest the vertical plane of the axis of the rotary kiln will be in a horizontal plane above that of the trough farthest from such vertical axis. During all the time the marl and slurry or other cement-forming material is in the trough it will be subjected to the action of the heat radiating from the kiln and directed by the jacket into contact therewith and as the temperature will be so high that the wet material will be dried in advance of its entrance to the kiln, so that less heat will be required in the kiln to effect the calcining operation, while the escape by radiation of waste heat is prevented by the jacket 15.

The slurry or other material introduced

into the troughs is moist and will cling to the helical conveyer to such an extent as to clog the trough unless the conveyer is cleaned at intervals, and for this purpose there is employed an automatic cleaning device 40, one of which is used for each section of the conveyer. At one side of and preferably supported by the trough 32 are brackets 41, serving as supports for a rod 42, that extends parallel with the trough. On this rod are mounted a number of levers 43, having forked end portions 44, that are shaped to conform to a portion of the helix, and the ends of the forks extend under a flange formed by securing an angle-iron 45 to the inner wall of the trough, as shown in Figs. 9 and 10. The outer end of each lever 43 is provided with a weight 46, which when the fork arrives at the end of the flange 45 will automatically raise the forks from engagement with the helix and a workman may then slide the lever back to initial position by hand in readiness for a subsequent cleaning operation. When once placed over a portion of the helix and the forked end inserted under the flange 45, the fork will be traveled to the opposite end of the helix with which it is engaged by the revoluble movement of said helix and at the same time will remove all of the slurry which may cling thereto. The heat may further be utilized in heating and drying the fuel preliminary to its introduction to the kiln, and this drying operation may occur at any time before the fuel is powdered.

In Figs. 6 and 7 is illustrated a fuel-drier in which two troughs 50 and 51 are arranged side by side, but disposed on convergent lines in much the same manner as the troughs 32 and 33. The fuel to be dried is placed in a hopper 52 and introduced to the first trough 50, being conveyed to the end of the latter by a helix 53. From the end of the trough 50 the fuel passes to the second trough 51 and is moved along said trough by a helix 54 and discharged to a pulverizing device of any desired character.

It will be observed that between the slurry-hopper 31 and the beginning of the open conveyer-trough 32 the slurry passes through a tube 60, that leads directly through the main flue or stack, so that at this point the slurry is subjected to the intense heat of the products of combustion passing from the kiln proper, and thus receives an initial temperature, which results in the more rapid and effective drying of the material, and it will be further observed that the discharge-spout 34 also leads through the main flue to the rear end of the trough and is again subjected to intense heat in advance of its entrance to the kiln, so that there will be no tendency to lower the temperature of the kiln by the introduction of comparatively cool material. A further advantage is gained by passing the air-tubes 23 directly through the main flue or stack, so that the air issuing from the jacket will be heated to high temperature before it reaches the blast-fan.

In the operation of the device a fire is first built in the front end of the kiln, and after a short time the hot air from the jacket will pass through the tube 23 to the fan 24 and be forced under pressure to the injector 27, at which point the comminuted fuel will be forced into the front end of the kiln and raise the temperature to the required point. The slurry or other material is then fed to the hopper 31 and passing through tube 60 receives an initial high temperature before it reaches the trough 32. While passing along the trough 32 the slurry is heated by radiation, and as the top of the trough is open the moisture will be driven off and the slurry will arrive at the end of the trough 32 in a comparatively dry condition and will thence travel by gravity to the entrance end of the trough 33. The comparatively dry material is now forced along the trough 32 and again subjected to the action of heat radiating from the kiln and jacket and is finally heated by passing through the discharge-trough to the kiln. The calcined material falls into the chamber 8 at the front end of the kiln and is directed to the clinker-pit 10. Inasmuch as the clinker-pit is directly under and in communication with the air-jacket, the heat arising from the clinkers will be directed into the latter and will mingle with the air entering said jacket, so that all of the heat will be fully utilized and at the same time the heat from the clinkers will serve to maintain the proper temperature at the front end of the kiln.

In cleaning or in the renewal of fire-brick the slide or gate 11 is closed in order to prevent the heat from the clinkers entering the jacket, and the supply of fuel being cut off the blast-fan 24 is operated to draw a current of cold air through the jacket, and thus cool the kiln, so that workmen may enter thereinto.

It will be observed that the surplus heat may be employed for the drying of any of the cement-forming material or fuel either at a distance from the kiln by conveying a portion of the air to the connecting-pipe 30 or that such air may be otherwise employed, as in the heating of a building or mill.

Having thus described the invention, what is claimed is—

1. The combination with an internally-heated revoluble kiln, of drying-troughs arranged above the kiln, and separated therefrom by an air-space, said troughs being heated by radiation from the kiln, and means for conveying the material to be dried lengthwise of said troughs.

2. The combination with an internally-heated revoluble kiln, of a pair of conveying-troughs arranged above the kiln, and separated therefrom by an air-space, said troughs being

subjected to the action of the heat radiating from the kiln, said troughs forming a continuous passage in the direction of the discharge end of said kiln and thence back again to the entrance end thereof.

3. The combination with a revoluble kiln, of a pair of convéying-troughs arranged above the kiln and subjected to the action of heat radiating therefrom, a connected portion of one of the troughs passing through the main escape-flue of the kiln.

4. The combination with a revoluble kiln having an escape-flue, of a conveying device arranged above the kiln and subjected to the action of heat radiating therefrom, the entrance end of said conveying device extending through the escape-flue.

5. The combination with a kiln having an escape-flue, of a drying device disposed above and heated by radiation from the kiln, the preliminary portion of the drying device extending through the flue and being subjected to the action of the products of combustion passing through said flue.

6. The combination with a revoluble kiln, of a curved casing, a pair of drying-troughs arranged on convergent lines above the kiln and forming a part of the casing, said troughs being disposed respectively at different angles on the curved surface of the casing and disposed in convergent lines, the troughs being so disposed that both shall be subjected to the action of heat for their entire length, and arranged at their communicating ends in different horizontal planes, and conveyers disposed in said troughs.

7. The combination with a kiln, of a pair of troughs, a feed-hopper at the end of one trough, and a discharge-spout at the end of the opposite trough, the connections between the hopper and trough and between the spout and trough extending through the main flue or stack of the kiln.

8. The combination with a kiln, of a jacket forming a cover for the upper portion of said kiln, and a drying-trough forming a part of the jacket.

9. The combination with a rotary kiln, of a substantially semicircular jacket forming a cover for the upper portion of the kiln, said jacket being opened at one end for the admission of air, and a drying-trough forming a part of the jacket.

10. The combination with a rotary kiln, of a jacket opened near one end for the admission of air, a drying-trough forming a part of the jacket, and an escape-flue leading from said jacket through the main flue of the kiln.

11. The combination with a rotary kiln, of a jacket covering the upper portion of the kiln and having rearwardly-extending flanges at its lower edges to form an inclosed air-space, and a drying-trough forming a part of the jacket.

12. The combination with a rotary kiln, of a clinker-pit, a jacket partly encircling the kiln and in communication with the clinker-pit, said jacket being provided with air entrance and discharge openings, and a drying-trough forming a part of the jacket.

13. The combination with a rotary kiln, of a clinker-pit, a jacket partly surrounding the kiln and in communication with one end of the clinker-pit, a drying-trough forming a part of the jacket, an air-discharge flue leading from the opposite end of the jacket, and inward-extending flanges arranged at the lower edges of the jacket for a portion only of the length of the latter.

14. The combination with a rotary kiln, of a clinker-pit, a jacket extending around the front end of the kiln and in communication with said pit, and a drying-trough forming a part of the jacket.

15. The combination with a rotary kiln, of a clinker-pit, a movable gate or closure for cutting off communication between the kiln and pit, a jacket extending partly around the kiln and communicating with the clinker-pit, and a fan for causing the flow of a current of air to said jacket.

16. The combination with a rotary kiln, of a clinker-pit, a gate or closure for shutting off communication between the kiln and pit, a jacket partly surrounding the kiln and having side doors for access to the pit, and a fan for causing the flow of a current of air through the jacket.

17. The combination with a rotary kiln, of a clinker-pit, a gate or closure for shutting off communication between the kiln and pit, a jacket partly surrounding the kiln, said jacket having air-entrance openings to the rear of the clinker-pit, and a fan for causing the flow of a current of air through the jacket.

18. The combination with a kiln, of a clinker-pit, a jacket partly surrounding the kiln and in communication with said clinker-pit, and a drying-trough forming a part of the jacket.

19. The combination with a rotary kiln, of a substantially semicircular jacket formed of a pair of spaced plates, a drying-trough forming a part of the jacket, and a lining of non-conducting material, said jacket having air entrance and escape openings.

20. The combination with a kiln, of a casing arranged around the upper portion of the kiln and forming an air-jacket, and a drying-trough forming a part of the casing.

21. The combination with a rotary kiln, of a casing covering the upper portion of the kiln, a drying-trough forming a part of said casing, and a trough feeder extending through the main flue or stack of the kiln.

22. The combination with a kiln, of an injector for the feeding of finely-divided fuel, a jacket partly surrounding the kiln, a discharge-tube leading from the jacket to the injector, and a fan connected in the tube and serving to force the air under pressure to said injector.

23. The combination with a kiln, of an in-

jector for forcing finely-divided fuel into the kiln, and a jacket partly surrounding the kiln, a discharge-tube leading from the jacket through the main flue of the kiln, a fan connected to the tube, and a second tube leading from the discharge side of the fan to the injector.

24. The combination with a kiln, of an air-jacket partly surrounding the kiln, an escape-flue leading from the jacket, and a fan connected to the escape-flue and serving to cause the passage of a current of air through the jacket and as a means for forcing said air under pressure to a point of consumption.

25. The combination with a battery of kilns, of a separate air-jacket partly surrounding each kiln, an escape-flue leading from each jacket, a tube connected to the several escape-flues, a fan connected to the tube, a fuel-injector at the front end of each kiln, and a tube leading from the fan and connected to each of said fuel-injectors.

26. The combination with a plurality of kilns, of fuel-injectors arranged one at the front end of each kiln, a jacket partly surrounding each of the kilns, a valved escape-pipe leading from each of the jackets, a tube to which all of the pipes are connected, a fan connected to said pipe, and a tube leading from said fan to all of the fuel-injectors.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JACKSON SHENEMAN.

Witnesses:
J. H. JOCHUM, Jr.,
J. ROSS COLHOUN.