No. 827,057. PATENTED JULY 24, 1906.

H. F. & D. H. CAMPBELL & T. H. SMITH.

J. L. CAMPBELL, EXECUTRIX OF H. F. CAMPBELL, DEC'D.

APPARATUS FOR COOLING ORE.

APPLICATION FILED DEC. 11, 1903.

2 SHEETS—SHEET 1.

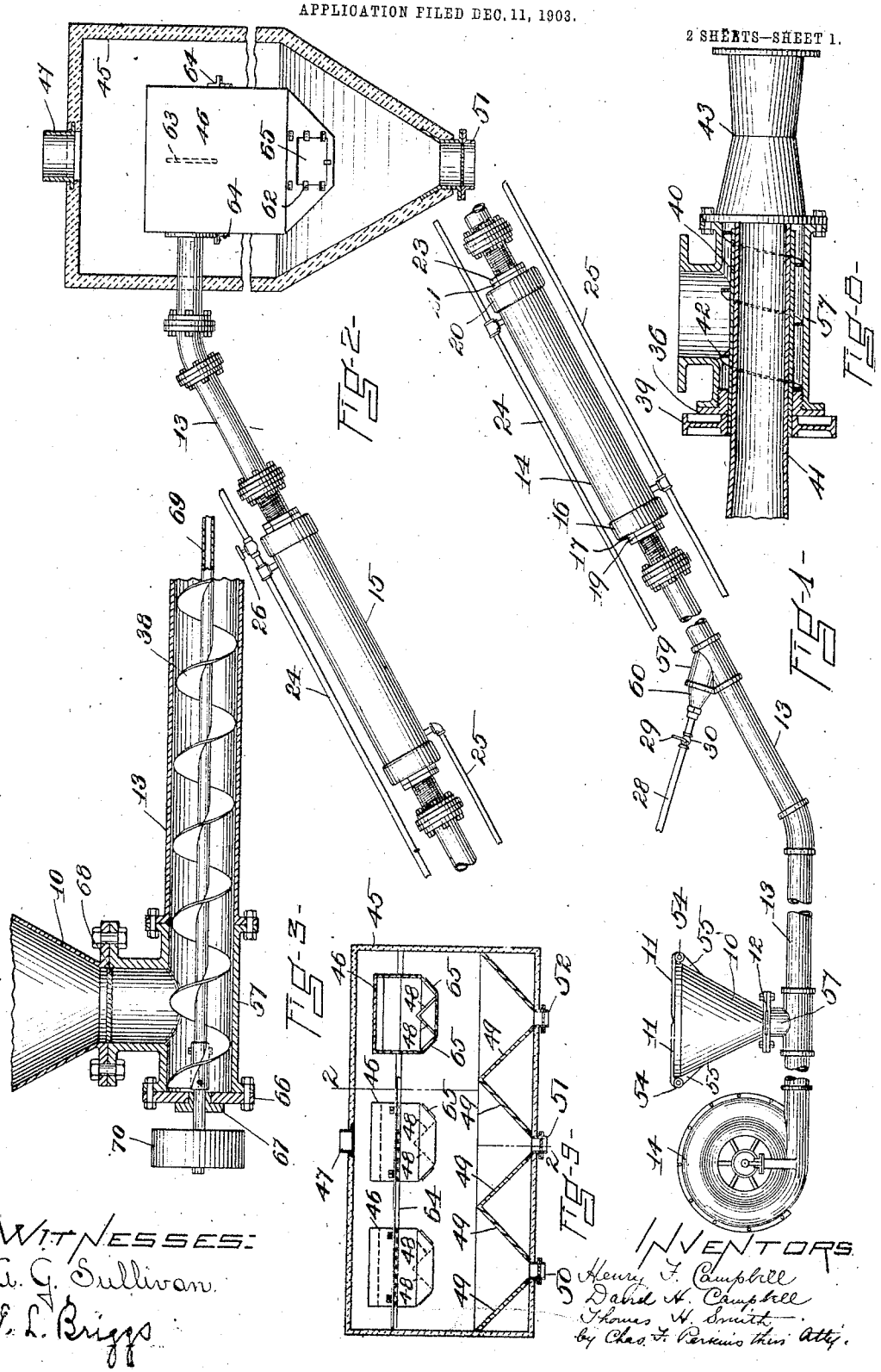

FIG-2-

FIG-3-

FIG-4-

FIG-5-

WITNESSES:
G. G. Sullivan.
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INVENTORS
Henry F. Campbell
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by Chas. F. Perkins their Atty.

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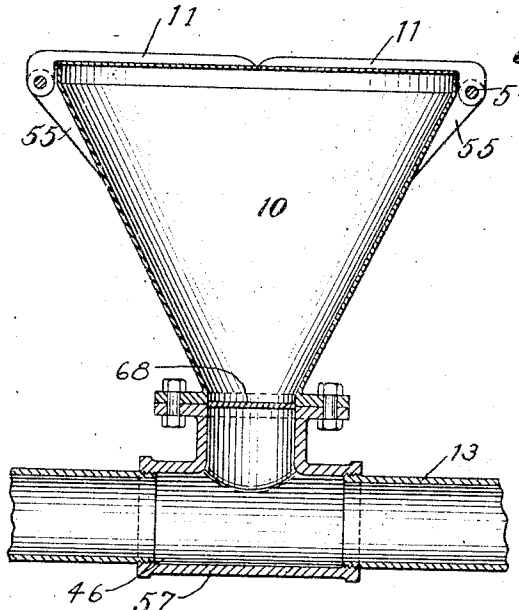

Fig-4-

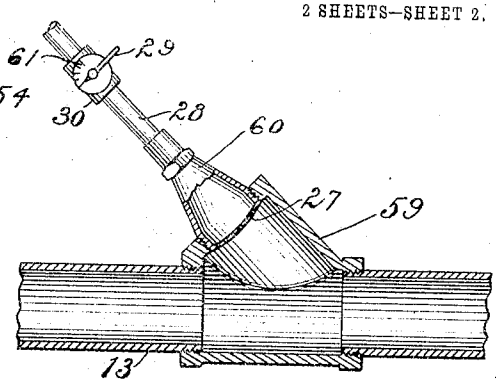

Fig-6-

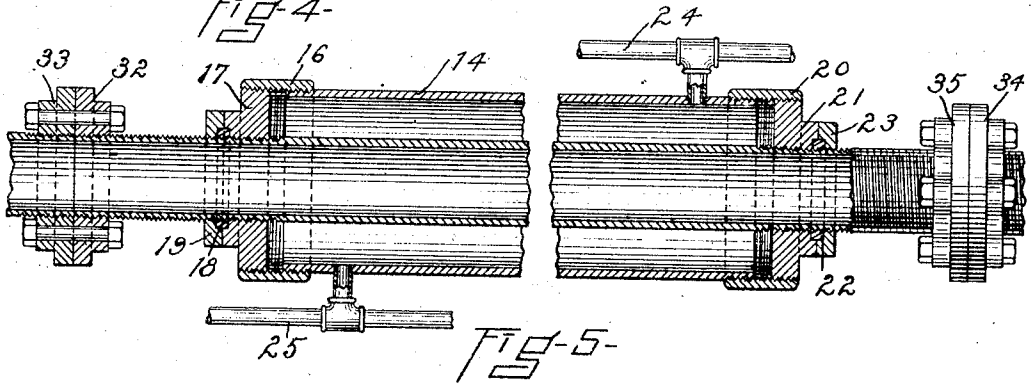

Fig-5-

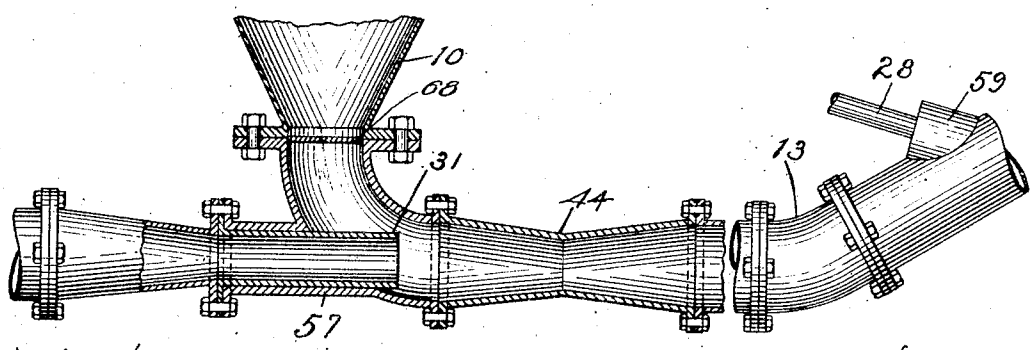

Fig-7-

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UNITED STATES PATENT OFFICE.

HENRY F. CAMPBELL, OF MELROSE, MASSACHUSETTS, AND DAVID H. CAMPBELL AND THOMAS H. SMITH, OF DENVER, COLORADO; SAID DAVID H. CAMPBELL AND SMITH ASSIGNORS TO SAID HENRY F. CAMPBELL; JEANNETTE L. CAMPBELL EXECUTRIX OF SAID HENRY F. CAMPBELL, DECEASED.

APPARATUS FOR COOLING ORE.

No. 827,057. Specification of Letters Patent. Patented July 24, 1906.

Application filed December 11, 1903. Serial No. 184,846.

To all whom it may concern

Be it known that we, HENRY F. CAMPBELL, residing at Melrose, in the county of Middlesex and State of Massachusetts, and DAVID H. CAMPBELL and THOMAS H. SMITH, residing at Denver, in the county of Denver and State of Colorado, citizens of the United States, have invented new and useful Improvements in Apparatus for Cooling Ore, of which the following is a specification.

Our invention relates to an apparatus for cooling, conveying, and elevating sand and light materials, and particularly ores preparatory to magnetically separating and concentrating same; and the objects of our invention are to convey and elevate sand and like materials in a closed conductor and to convey heated ore directly from the furnace to elevated dust chambers and bins and to cool the same rapidly while in transit. We attain these objects by the means illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of the blower, hopper, and lower portion of the conductor and connections. Fig. 2 is a side elevation of the upper portion of the conductor, one of the dust-chambers, and a vertical section of the bin on the line 2 2 of Fig. 9. Fig. 3 is a vertical section of the hopper and conductor, showing in elevation a modification of the means for conveying the ore. Fig. 4 is a vertical section of the hopper and a portion of the conductor. Fig. 5 is an enlarged longitudinal section of a portion of the conductor and one of the water-jackets. Fig. 6 is an enlarged view, partly in section, of the spray-pipe and a portion of the conductor. Fig. 7 is a vertical section of the hopper, showing the conductor partly in section and partly in elevation. Fig. 8 is a view, partly in section and partly in elevation, of a modification of the conductor shown in Fig. 7. Fig. 9 is a longitudinal section of the bin inclosing the dust-chambers, one of which is shown in section and the others in elevation.

Like numerals indicate corresponding parts throughout all of the figures of the drawings.

Referring to the drawings, 10 is a receiving-hopper of any convenient shape and of any suitable material.

11 represents metal covers hinged at 54 to the brackets 55, which are cast on the hopper. The covers 11 cover the top of the hopper and fit closely together in such a manner as to prevent dust and fumes from escaping.

At the throat of the hopper is an opening 12, Fig. 1, having a horizontal metal plate 68, Figs. 3, 4, and 7, fitted and adapted to slide therein to regulate the flow of the material from the hopper.

13 is a conductor consisting of an iron pipe of any convenient diameter and composed of any number of sections having flanged ends bolted together in the usual manner.

14 is a blower or fan of any suitable construction connected with the conductor 13 in such manner as to discharge an air-blast therein.

28 is a supply-pipe for cold water for the purpose of injecting a stream of water directly into the heated contents of the conductor at 59. (See Figs. 1 and 7.) In Fig. 6 we have provided the pipe 28 with a nozzle 60, having perforations 27 therein for the purpose of causing a spray of water to be discharged into the ore. The form of the stream injected into the conductor is not essential to our invention and may be modified in various ways.

59 is a branch of the conductor 13 and is screw-threaded on the inside to receive the screw-threaded end of the supply-pipe 28.

It is obvious that other methods of joining the various parts of the conductor and its connection than those shown and described may be employed without departing from the substance of the invention. It is only necessary that the joints shall be water-tight.

The pipe 28 is provided with the cock 29, having an index-pointer and a scale 61 to indicate the degree of opening of the pipe 28.

14 and 15 are water-jackets surrounding and inclosing portions of the conductor 13, the details of construction of the water-jacket 14 being shown in Fig. 5. 17 and 21 are nuts which constitute the heads of the water-jacket 14 and are fitted to the screw-thread upon the outside of the conductor 13. They are connected to the water-jacket 14 by means of the rings 16 and 20, which have internal screw-threads fitting the screw-threads

upon the heads 17 21 and upon the ends of the water-jackets 14. 19 and 23 are lock-nuts between which and the heads of the water-jacket are suitable packings 18 and 22, which serve to form water-tight joints. 24 is a supply-pipe, and 25 is a waste-pipe, for the water-jacket 14. The water-cock 26 (shown in Fig. 2) is for the purpose of regulating the supply of water to the water-jacket. 32 and 33 are screw-threaded collars or nuts fitting the external screw-thread of the conductor 13. These nuts 32 and 33 serve the purpose of flanges upon the conductor for uniting two sections of the conductor. The said nuts are bolted together in the ordinary manner of joining the flanges of two sections of pipe. It is necessary to employ the said nuts instead of flanged ends of the pipe in order that they may be removed to allow the head 17 and the lock-nut 19 to be first applied to the conductor. 34 and 35 are similar screw-threaded collars or nuts used for the same purpose as 32 and 33.

The conductor 13 discharges into a dust-chamber 46. (Shown in Figs. 2 and 9.)

63 is a metal sheet or plate immediately in front of the discharge end of the conductor for the purpose of scattering the ore particles as they impinge upon it by the force of the air-blast.

In practice a number of conductors and dust-chambers may be used and may be of any desired form.

48 represents inclined surfaces for deflecting the ore through openings in the bottom of the chamber, which openings are provided with doors 65. 62 represents metal clips which serve to secure the doors 65 to the walls of the chamber and at the same time permit them to slide up and down. The size of the said openings can thus be regulated by the adjustment of the doors 65.

45 is a bin made of fire-clay or other non-combustible material and of any suitable shape, preferably rectangular in cross-section and with one or more hopper-shaped bottoms, each of which is directly beneath a dust-chamber.

64 represents angle-irons secured to the inner walls of the bin 45 and supporting one or more dust-chambers. 47 is a ventilator at the top of said bin and is for the purpose of permitting the escape of gases and vapors collecting therein and may be provided with screens to prevent losses by escape of dust.

49 represents the inclined walls forming the hopper-shaped bottom, and 50, 51, and 52 the outlets of the bin through which the cooled ore is discharged.

It is evident that a single dust-chamber may be employed and inclosed in a bin adapted in size thereto, or the dust-chamber may be dispensed with and the conductor discharge directly into a bin.

In Fig. 3 the blower 14 is dispensed with and other means than an air-blast are shown for conveying the ore. 69 is a hollow shaft bearing thereon a screw 38, the whole being actuated by the pulley 70. The end of the conductor 57 is closed by the cap 66, bolted to the flange thereon. The opening in the cap 66 through which the shaft extends is provided with a flanged bushing 67. Water may be circulated through the shaft 69 to aid in cooling the ore.

Referring to Fig. 7, the piece 57 of the conductor 13 is a gooseneck or curved section of pipe and has a branch cast integral therewith into which is inserted and tightly fits the nozzle 31 of the blower 14. The nozzle extends slightly beyond the throat of the hopper 10 into the conductor 13, so as to avoid any tendency of the air-blast to cause the ore to be forced back out of the hopper. The nozzle 31 is provided with a flange which is bolted to a flange on the piece 57 to form a joint of the usual construction. The conductor is contracted at 44 to about the diameter of the nozzle 31, the effect of which is to increase the velocity of the air-blast at that point, producing a suction which overcomes any tendency of the dust and fumes by reaction to escape through the hopper.

In Fig. 8 a modification of Fig. 7 is shown by means of which the ore is conveyed by a positive movement beyond the throat of the hopper. 41 is the nozzle of the blower corresponding to 31 in Fig. 7. 40 is a revolving sleeve bearing thereon the screw 42 and being actuated by the pulley 39. 36 is a nut or head effectually closing the space around the nozzle 41 at this point. 43 is a contraction of the conductor corresponding to 44 in Fig. 7.

The method of operation of our apparatus when used for conveying and cooling ore is follows: We regulate the speed of the fan or blower 14 so as to create a blast of air of sufficient force to carry the ore through the conductor 13. We find ordinarily that a four-ounce current is sufficient. The covers 11 are opened so as to allow the admission of a stream of ore of sufficient volume to keep the hopper practically full. The ore in a pulverized and heated state is then delivered into the hopper from the furnace. The ore descends from the hopper and enters the conductor 13 in the path of the air-blast by which it is carried to the dust-chamber 46. As the ore passes the point where the pipe 28 discharges into the conductor water in the form of a fine spray is mingled with the ore. The pipe 28 is provided with a cock inclosed in the casing 30. The cock is provided with a handle 29, terminating in an index-finger, which in connection with the scale 61 enables the operator to regulate accurately the flow of water through the pipe 28. It is unnecessary to employ a spray, as the water coming in contact with the hot ore is almost immediately converted into steam and is carried

along with the ore particles, air, and gases through the conductor. The flow of water through the pipe 28 should be regulated so that the quantity is no greater than will be instantly converted into steam and will permit the particles of ore to enter the bin in a dry state and not adhering together. In Fig. 7 we have shown a straight pipe 28 without a perforated nozzle for supplying a jet of water to the ore. The temperature of the ore is reduced by the water admitted through the pipe 28 and that in the water-jackets which is kept cool by the constant circulation. When the ore passes into the dust-chamber 46, it strikes against the buffer 63 and falls down on the inclined surfaces 48, by which it is deflected out through the side openings at the bottom. The gases and vapors which have come up with the ore through the conductor now rise and pass off through the ventilator 47 in the top of the bin 45. The doors 65 may be raised or lowered and the discharge of the ore from the dust-chambers regulated. The ore discharged from the dust-chambers falls upon the inclined surfaces 49 of the hopper-shaped bottom and is finally delivered through the outlets 50, 51, and 52. When the supply of ore to the hopper is discontinued, we find it desirable to close the covers 11, because there is a tendency of the air-blast to expel the material from the hopper through its inlet if the hopper is only partially filled. The construction shown in Fig. 3 could only be employed when the character of the work would permit the use of a straight conductor. In such instances the ore can be conveyed by the spiral 38 and can be cooled while being conveyed by the same devices and in the same manner hereinbefore described in connection with the air-blast. In Fig. 7 the nozzle 31 projects so far beyond the throat of the hopper that there is no tendency to expel the ore or fumes out through the hopper 10. The result of so locating the nozzle 31 is that the ore is all removed from the hopper by gravity and suction and is discharged by the conductor. This suction is further aided by the contraction 44 of the conductor 13. By employing the construction shown in Fig. 8 gravity and suction alone are not depended upon to deliver the ore in the path of the air-blast; but the spiral 42 insures a positive delivery of the ore at the proper point to be acted upon by the air-blast to the best advantage.

While we have described our invention with special reference to ores, we do not desire to be understood as limiting ourselves strictly to this class of material, but desire to include all pulverized materials susceptible of being conducted and elevated in the manner described. In the employment of the apparatus described for this purpose the cooling devices may be dispensed with. The water-jackets here shown are complete in and of themselves. They are constructed so as to be easily put together and taken apart.

After the water passes through the jackets it is somewhat heated; but, if desired, it can be used in a wet separator, and after the water has become cool it may be used over again.

The joints of the various sections of our apparatus are very simple and water-tight and are capable of being taken apart easily and readily shipped.

In the treatment of ores for maguetic separation it is important to cool the ore quickly after its discharge from the furnace, as the degree of exposure to heat must be accurately controlled in order to get the best results. Our invention enables us to take the ore directly from the furnace into the hopper. The air-blast drives the ore through the conductor in a few seconds, subjecting it in its passage to direct contact with cold water and to the cooling effect of the water-jackets, which may be arranged to inclose so much of the conductor as the constructor desires. The apparatus enables us to elevate the ore in its transit and to locate the bin at the most convenient point for the delivering of the ore into the separating-machines, if such be used. It also enables us to confine the ore while being cooled and delivered from the furnace to the separating-machine, and thereby to avoid dust and fumes which are at times almost suffocating when the ore is exposed. In loading or moving sand or other fine materials our apparatus is especially useful and has the important advantage that the material is driven by the air-blast and there is no obstruction to its travel to the outlet of the conductor.

What we claim, and desire to secure by Letters Patent, is—

1. In an apparatus for conveying and cooling ore, the combination of units each consisting of a central conductor, a jacket inclosing the same, means for causing a circulation of water through said jacket, said central conductor having its ends provided with couplings, and said jacket consisting of a cylinder and circular nuts forming heads thereof connected together by annular screw-threaded rings.

2. In an apparatus for conveying and cooling ore, a conductor, means for discharging an air-blast into said conductor, means for discharging material into said conductor and into the path of said air-blast, said conductor having a contraction in the diameter thereof at a point beyond where the material is discharged into the same, and said conductor being expanded immediately beyond said contraction combined with a water-jacket surrounding said conductor, means for causing a circulation of water through said jacket, and said jacket consisting of a cylinder and circular nuts forming the heads thereof con-

nected together by annular screw-threaded rings; a feed-pipe discharging water into said conductor, and means for regulating and registering the supply of water therein.

3. In an apparatus for conveying and cooling ore a conductor provided with a gooseneck at the receiving end, a hopper arranged to discharge therein, a nozzle entering said gooseneck, means for discharging an air-blast into said conductor through said nozzle, said conductor having a contraction in its diameter at a point beyond where the air-blast is discharged therein, and said conductor being expanded immediately beyond said contraction, combined with a water-jacket surrounding said conductor, means for causing a circulation of water through said jacket; said jacket consisting of a cylinder and circular nuts forming the heads thereof, connected together by annular screw-threaded rings, and a feed-pipe discharging water into said conductor, and provided with a cock and gage for regulating and register ing the flow of water through the same.

In testimony whereof we have hereunto set our hands, in presence of two subscribing witnesses, this 18th day of September, 1903.

HENRY F. CAMPBELL.
DAVID H. CAMPBELL.
THOMAS H. SMITH.

Witnesses to signatures of Henry F. Campbell and David H. Campbell:

ELMER L. BRIGGS,
CHAS. F. PERKINS.

Witnesses to signature of Thomas H. Smith:

G. HOWARD SUNDLEY,
MAYME A. MCDONALD.