

March 22, 1960

R. M. RONNE

2,929,119

MACHINE FOR MAKING SHELL CORES

Filed June 7, 1957

3 Sheets-Sheet 1

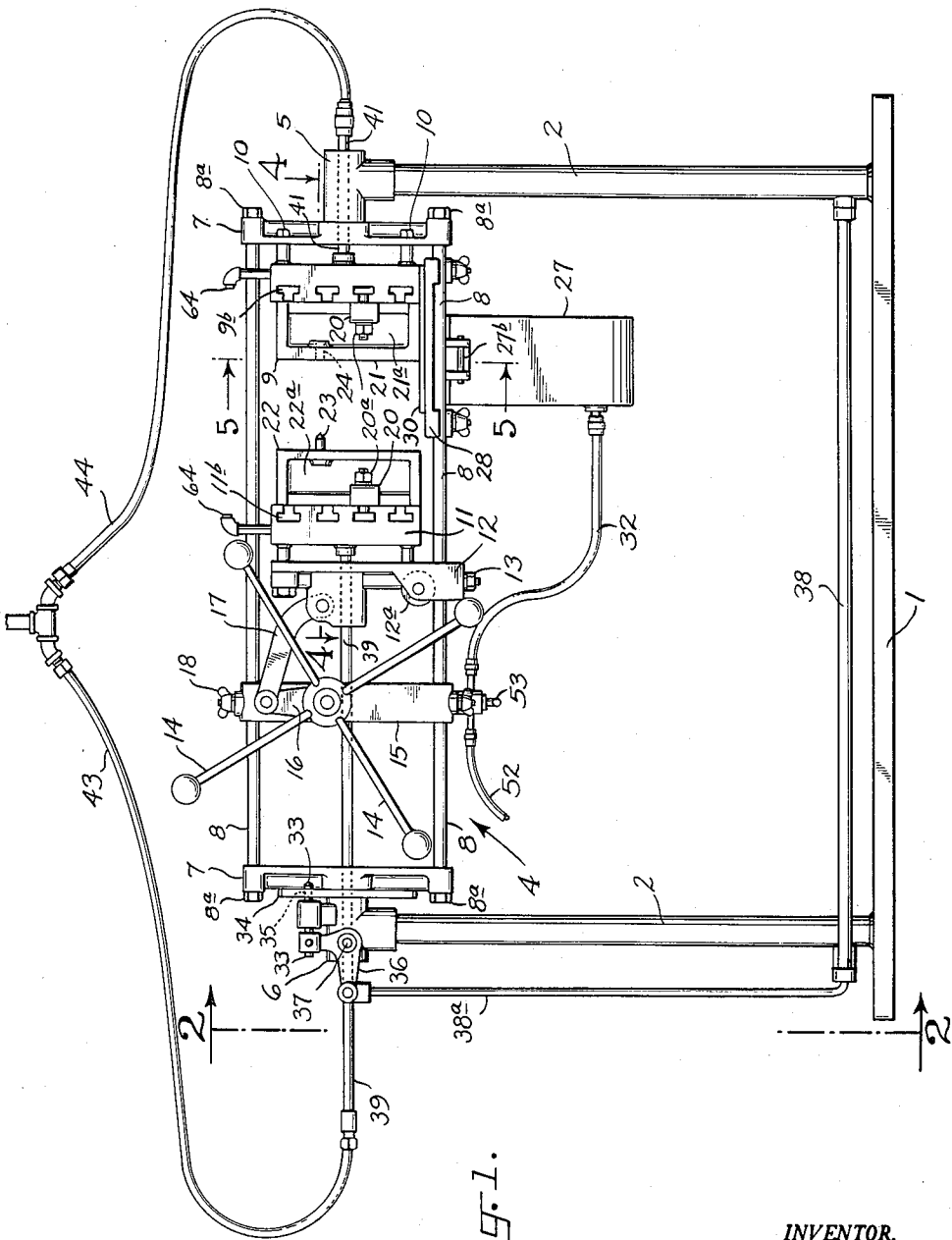


Fig. 1.

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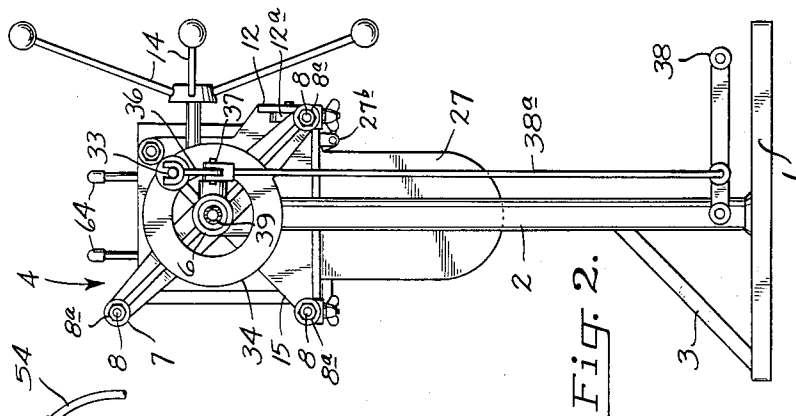


Fig. 2.

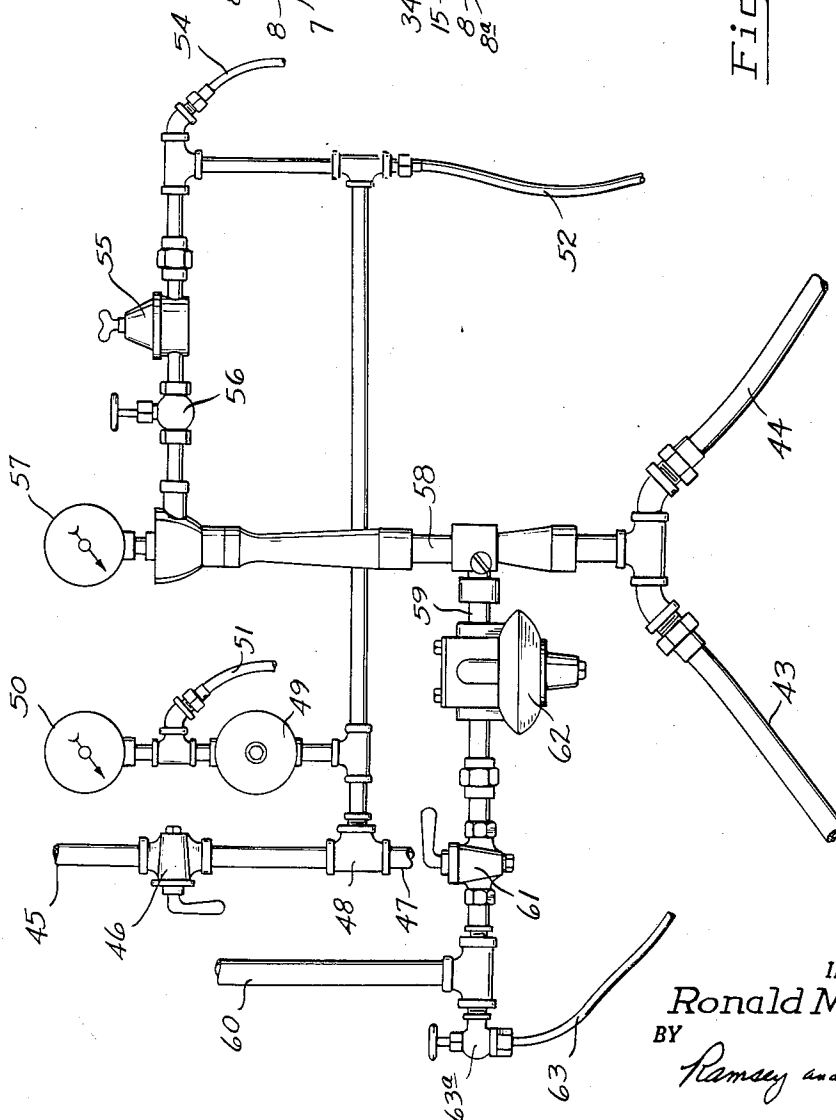


Fig. 3.

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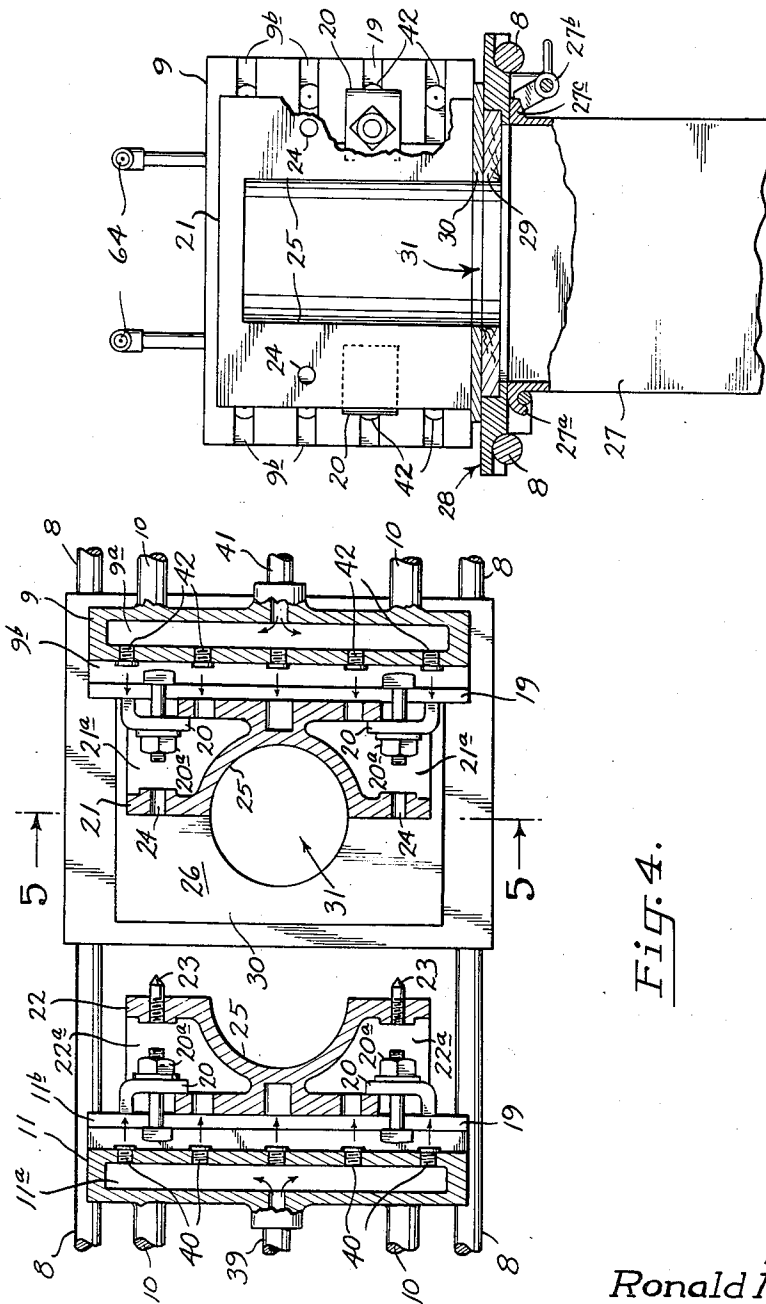


Fig. 5.

Fig. 4.

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2,929,119

MACHINE FOR MAKING SHELL CORES

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Application June 7, 1957, Serial No. 664,339

8 Claims. (Cl. 22-10)

My invention relates to a machine for making cores from resin-coated sand. These are generally referred to as shell cores, and are used for defining apertures in metal castings.

One of the principal objects of my machine is to provide a simple machine which may be used by an ordinary job shop to make such shell cores efficiently and inexpensively. In the past, it has been common practice to make such shell cores by the use of electrical resistance elements. The use of electrical resistance elements requires that the mold boxes in which said sand cores are made have tight, face-to-face connection with the resistance elements so as to produce good heat conductivity. Thus, close fitting parts, high precision, and the selection of good heat-conductive metals are required, so that heat will be transmitted adequately and uniformly to the molds, to produce shell cores of uniform thickness and cure.

Shell cores are made by mounting the separable parts of a mold between face plates and holding them in tight, face-to-face relationship. One end of the mold is open, and all other portions are substantially closed. A quantity of resin-coated sand is poured into the cavity defining the core, the mold is heated, and the thickness of the shell core is determined by the time in which the resin-coated sand is in contact with the peripheral surface of the cavity in the mold. After such time, the sand which has not been plasticized and set is discharged, the cure is continued, and thereafter the mold halves are separated and the shell core thus produced is discharged to accommodate the next operating cycle.

I have discovered that efficient formation of such shell cores may be accomplished by directing a jet, or jets, of a combustible air-fuel mixture directly against the external surfaces of the mold box, and if said jets are uniformly patterned and dispersed over the mold box halves, shell cores may be produced quickly and of uniform excellence. That is to say, flame being projected upon the mold box halves eliminates any intervening heat transmitting mechanism, and the precision and expense of mounting the mold box halves and the heating elements is thus eliminated.

A further and more specific feature of my invention is to direct said combustible mixture and consequent flame over the faces of the mold box halves by spaced, plural jets arranged in a predetermined pattern, said flame being directed as jets from multiple nozzles which project flame through apertures in the heads upon which the mold halves are supported, so as to obtain uniformity of heat within said mold box halves.

A further and more specific object of my invention, and a feature thereof, is to provide an auxiliary, lateral passageway, or passageways, between said mounting

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heads and the external surface of a mold box half so that the jets will strike, disperse, and flow over substantially the entire surface of the mold box halves, to eliminate any lack of uniformity of heat within the cavity of the mold box, so as to produce shell cores of uniform thickness and cure.

A further and more specific object of my invention is to provide a machine for producing the aforesaid objects in a simple and efficient manner, with inexpensive mechanisms.

Other and further features of my invention are herein-after described with reference to the accompanying drawings, in which:

Fig. 1 is a front elevation of a machine embodying my invention;

Fig. 2 is an end view thereof, looking at the left end as shown in Fig. 1;

Fig. 3 is a diagrammatic or schematic view of typical pipe connections for air and gaseous fuel used in connection therewith;

Fig. 4 is a sectional view taken substantially on the line 4-4 in Fig. 1; and

Fig. 5 is a transverse section taken on the line 5-5 in Fig. 4.

A machine embodying my invention comprises an elongated base 1, adjacent the ends of which two vertical supports 2 are mounted. Said supports are joined to the base by diagonal braces 3 (see Fig. 2). A reel 4 is journaled between bearings 5 and 6 carried by the ends of said braces. Said reel comprises diagonal end members joined by longitudinal rods 8. Said longitudinal rods are threaded at their ends and secured to the end members by nuts 8a. Said end members and the longitudinal rods define a firm structure, that is, a reel which is quite stiff.

A fixed face plate 9 is fastened to the right-hand end member 7, as viewed in Fig. 1, by nuts and bolts 10. A movable face plate 11 is supported by a carriage 12, having an antifriction roller 12a which traverses one of the longitudinal rods 8. Said antifriction roller is maintained in good engaging arrangement with said longitudinal rod by a slack take-up device actuated by nut 13. An operating wheel 14, journaled in frame 15, is secured to the carriage by means of an arm 16 and link 17. Said frame is adjustably fixed to the other one of said longitudinal rods by a thumb nut 18.

Each of said face plates 9 and 11 is provided with laterally disposed, T-shaped slots 19, to which work-holding clips 20 can be secured by take-up nuts and bolts 20a. One half 21 of a mold box is secured to the fixed face plate 9, and the other half 22 is secured to the movable face plate 11. These mold box halves are joined to the face plate by means of the clips and take-up nuts and bolts, as is shown most clearly in Fig. 4. One of said mold box halves, such as half 22, is provided with pilot pins 23, and the other half is provided with pilot holes 24. Thus, when the two halves of the mold box are in face-to-face abutment, the pilot pins and holes maintain them in exact registration. The pilot pins preferably have tapered ends and also tapered sides, so as to take up wear and to secure exact registration.

Within said mold box halves, a cavity 25 is formed to produce the peripheral outline of a shell core to be produced. The mold box half shown in Fig. 4 is to produce substantially a cylindrical core, but it is to be understood that any cores, or multiples thereof, may be produced in a mold box. Thus, the mold boxes occupy

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a definite station between the opposed faces of the face plates, and I term the space occupied by said mold box halves as a mold box station 26.

Underlying said station is a receptacle 27 for plastic coated sand, of which the shell cores are to be constructed. As is shown in Fig. 1, said receptacle underlies the mold box station, and it is in this position that it lies when the mold box halves are secured to their plates prior to the formation of a shell core. Said receptacle underlies an annular mouthpiece 28, and is supported by a pair of ears 27a at one side (see Fig. 5) and by a latch 27b on the other side. This permits the receptacle to be released by the latch, to permit entire or partial separation from the machine, to fill it with sand or to empty sand therefrom. In normal operation, it occupies the position shown in Fig. 5, with the latch 27b engaging a projecting lip 27c on said receptacle. Overlying the annular mouthpiece is a piece of insulating material, such as plywood 29 having a hardboard facing 30. Said insulating member, comprising the plywood board 29 and the hardened facing 30, has an aperture 31 formed therein, which comes into registry with the open end of the cavity 25 when the parts are arranged to produce a shell core. This is illustrated in Fig. 5.

An air line 32 opens into the lowermost portion of the receptacle, as viewed in Fig. 1, so that air under pressure may be released into the interior of the receptacle 27 to blow plastic-coated sand therefrom into the cavity 25 when the reel 4 is rotated 180° so as to bring the receptacle into superimposed relation with said cavity. Said air under pressure aids gravity in discharging sand from the interior of the receptacle to fill said cavity. The parts are arranged in the manner shown in Fig. 1 before an operating cycle is commenced. Said parts are held by a latch pin, which engages a circular plate 34 upon one end of the reel. Said latch pin is in engagement, as is shown in Fig. 1, being maintained by a spring bias. The pin may be retracted from the aperture 35 in the circular plate by a bell-crank lever 36, pivoted on a trunnion 37 fixed to the bearing 5 at the right-hand side of said machine, as viewed in Fig. 1. It is operated by a treadle 38 through a link 38a. Preferably, there is but one aperture 35, and thus the reel is free to rotate at all times, except when the latch pin 33 engages said aperture. Thus, the reel is adapted to be moved throughout substantially 360° of rotation without restraint.

A section of metallic tubing 39 extends axially through the bearing 6 and through the associated end member 7 therein. Said tubing is slidable therein and leads to a chamber 11a in the movable face plate 11. Said section of metallic tubing is provided for delivering air-fuel intermixture from the supply, later to be described, to said chamber, and from said chamber to a plurality of nozzles 40, which direct jets of flame toward and over the adjacent face of the mold box half 22 through elongated slots 11b in said movable face plate. A similar metallic tube 41, extending axially through bearing 5, directs an intermixture of combustible air fuel to chamber 9a and the fixed face plate 9, to supply nozzles 42 which project jets of flame through slots 9b in said fixed face plate.

In Fig. 3, I have illustrated a diagrammatic or schematic pipe diagram showing a typical installation for air and gas flowing to a machine embodying my invention. Flexible conduit 43 leads to the metallic tubing 39, and flexible conduit 44 leads to the metallic tube 41 at the opposite ends of a machine embodying my invention. Air is supplied through pipe 45, controlled by a shut-off cock 46. Said air supply line preferably is arranged vertically, and one vertical extension 47 thereof leads to a water trap (not shown). I preferably provide a means for blowing out of said air line adjacent T 43 comprising a regulator 49, a gauge 50, and a blow-off connection 51. A supply line 52 for directing air into the receptacle 27 is controlled by a shut-off or blow valve

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53, as is shown in Fig. 1. I also preferably provide a connection 54 for a clean-off gun for use in keeping the machine clean. Air for promoting air-fuel intermixture is controlled by a regulator 55 and needle valve 56. The regulator may be set to a predetermined pressure, such as thirty pounds to the square inch, which I have found to be adequate. This attained air pressure is registered upon gauge 57. Air is discharged into a mixer valve 58, as is combustible gas from the supply line 59. Said intermixture of gas and air flows through the flexible conduits 43 and 44 in the manner previously described. The combustible gas is supplied by a main line 60, controlled by a gas cock 61 and a regulator valve 62. I preferably provide a small, flexible connection 6, controlled by a valve 63a, for supplying fuel for an ignitor with which the flame is initially lighted.

As has been pointed out heretofore, said air-fuel mixture flows through the flexible conduits 43 and 44, and is discharged into the chambers 11a and 9a, respectively in the movable and fixed face plates 11 and 9, respectively. When I am utilizing elongated core molds, that is, those which extend above the face plates, I preferably provide additional nozzles 64, which extend above and over said face plates, as is shown in Figs. 1 and 5, respectively, so that jets of combustible gas may be directed upon those portions of the molds which lie above the face plates, thereby to obtain uniformity in heating of said elongated molds. In heating molds of the usual height, they will lie within the peripheral outline of the face plates.

As is shown in Figs. 4 and 5, I provide a plurality of nozzles at more or less uniform spacing, transversely and lengthwise of the face plates, so that the projected jets will strike the adjacent faces of the mold boxes uniformly, to produce uniform temperature thereof. Said mold boxes preferably are made of aluminum, or other metal, which is highly conductive of heat. Said nozzles are also aligned with the slots 19 so that the jets of burning gas will strike directly upon the adjacent face of the mold boxes. Said slots also permit the flame thus resulting to sweep laterally across the mold boxes to promote a uniform application of flame thereacross.

More or less conventional forms of mold boxes may be utilized with my machine, but I prefer to have them constructed somewhat in accordance with those shown in section in Fig. 4. Thus, said mold boxes are hollowed out on their external surfaces, and the cavities 21a—22a, respectively, form additional chambers in which the flame may sweep across the external portions of the mold boxes, to provide efficient and uniform heat transmission from the flaming gas to the mold cavity in which the shell cores are to be formed.

My machine and its associated parts operates substantially as follows:

The mold box halves are preliminarily heated to a temperature of about 500° F. after they have been clamped to the face plates and are in registration with each other. Then the treadle 38 is depressed by the operator's foot, which releases the latch pin 33, and the operator may then grip one of the longitudinal rods 8 to rotate the reel 4 approximately 180°. This will bring the receptacle 27 above the mold boxes, and sand will flow into the internal cavity 25 between the two mold box halves. Flow of sand from said receptacle is accelerated by causing air under pressure to flow through the conduit 52, to blow sand into said cavity. After a period of time, which in the usual case is about five seconds, the reel is returned to its original position and there locked. The sand is preferably covered with a thermosetting resin, usually of the phenolic type, which is a standard product.

The thickness of the walls of the cores being formed depends upon how long heat is applied to the resin-invested sand within the inverted mold boxes. The mold boxes are of the usual type, split upon appropriate margins, and they are usually two piece.

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The investing time is usually from five to ten seconds. It is during this time that the sand fills the interior cavity of the mold box, with portions of the sand lying immediately adjacent the walls of the cavity, where it is subject to elevated temperatures, usually about 500° F. After the reservoir is returned to its original position, as is shown in Fig. 1, the sand which has not been solidified flows back into the reservoir, and the mold box halves are kept clamped together for an additional period of time before they are opened. This is usually about twice the investing time. The shell cores thus produced are solid, and they may be removed from the molds by appropriate handling tools. They are lifted from the cavity and are placed upon a bench or other surface to cool.

In the past, when electrical resistance elements were used to heat the mold cavity faces, it was necessary that all of the parts be close fitting so that the core molds would be heated to uniform optimum temperature. This requires substantially rigid clamping devices, extreme precision in mating the plane surfaces, and complicated control mechanisms to prevent hot spots and thin walls from forming. By directing a flame directly upon the mold boxes by a series of jets, and causing them to spread more or less uniformly over the face, such hot spots are eliminated. Also eliminated is differential investing. If, for example, there is an area which is recessed more than the usual depth of the cavity, said jets may be arranged to flow directly over said area. This area may be heated also by adding a heat-conducting rod, which tends to localize or focus the heat over this area so as to produce uniformity in temperature.

Within the term of reference to "combustible gas," I wish to include carbureted liquid and comminuted, hard fuel-air mixtures either of which would produce a highly combustible mixture. I preferably use a combustible mixture of gas and air. As far as I have been able to determine, it makes little difference whether this is manufactured gas, natural gas, or bottled gas. The B.t.u. content of the several combustible portions of the air-fuel mixture differs, but the optimum temperature may be attained by varying the several controls. Thus, when optimum temperature is attained, and the flow of combustible mixture is maintained, the temperature will remain substantially constant. That is to say, the temperature may be controlled by varying the flame size and the air-gas intermixture.

As I have pointed out heretofore, I prefer to make the mold boxes of aluminum or other material having good heat conductivity. I preferably provide mold boxes with hollow backs, as is illustrated in Fig. 4, so that the flame may be applied in a wiping action as close to the surface of the cavity in the mold box as is possible. Said hollow backs also serve as an elongated passageway in which the jets flow as a stream, to produce uniformity of applied heat.

In accordance with standard practice, I preferably provide minute bleeder holes or spaces, so that when investing sand is brought into the cavity, air may flow therefrom. The apertures should be of such small cross-sectional area as to pass said air under pressure, but to restrain the discharge of the small, coated granules of sand.

As is shown in the drawings, the frame 15 may be locked in selected position upon one of the longitudinal rods 8 by tightening the thumb nut 18. Thus, when the hand wheel 14 is rotated clockwise, as viewed in Fig. 1, it will rotate the arm correspondingly and push the link 18 toward the right. The length and proportion of said arm and link, and the original positioning of the frame 15, are such that when the two mold box halves 21—22 are in face-to-face abutment, the arm 16 and the link 18 are just past center so that reverse movement is inhibited.

The insulating member 29—30 arranged intermediate

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the mold box half 21—22 and the reservoir or receptacle 27 serves to prevent the heat given off by the mold box halves from heating the reservoir, which would tend to plasticize and set the resin coating sand within said receptacle. The hardboard face 30 provides a smooth, dense surface, which fits tightly against the under surface of the mold box halves and tends to prevent leakage of air and sand therefrom. The proportioning and registration of the aperture 31 with that of the cavity 25 tends to promote ready flow of sand from the receptacle into said cavity, and vice versa.

The longitudinal rods 8 are preferably of circular cross-section. Thus, they may be rotated slightly to present multiple, smooth, plane surfaces for the anti-friction roller 12a. That is to say, if said longitudinal rod tends to become uneven or rough, it may be rotated slightly about its longitudinal center by slacking off the nuts 8a and rotated say 15°. Thus, a new surface is brought into operative relation with the peripheral surface of the antifriction roller. Experience has demonstrated that rotation of said rod will cause it to remain in smooth operating condition substantially for the life of said machine.

The schematic diagram of air and gas supply, regulators therefor, and adjusting valves, controls, and flexible conduits, is intended to be exemplary. The arrangement of such parts varies in different installations, and depends to some degree at least upon the construction of the facility, the needs of the operator, and the position of the utility or service pipes for said fluids.

I claim:

1. In a shell core forming machine, a support, a pair of opposed face plates laterally movable thereon, each face plate having at least one aperture extending there-through, core box halves secured respectively to said face plates, and at least one nozzle carried by each face plate for discharging an air-fuel combustible intermixture through an aperture in said face plate directly upon a mold box half secured thereto, an enclosed elongated passageway defined in each core box half opening endwise to the atmosphere lying at the discharge side of said aperture, and extending laterally across the adjacent surface of a core box half thereby to direct the heated products of combustion of the air-fuel intermixture, in wiping contact with the core box half, to maintain uniform elevated temperature therein.

2. In a shell core forming machine comprising a support, a pair of opposed face plates laterally mountable thereon, said face plates each having at least one aperture extending therethrough, and mounted core box halves removably fixed to said face plates, respectively, and a heating device comprising at least one nozzle carried by a face plate for a combustible air-fuel intermixture, said nozzle being arranged distantly from each of said core box halves discharging through an aperture in said face plates directed against each core box half, said apertures in said face plates, respectively, constituting fastening connections for joining the core box halves therewith.

3. In a shell core forming machine comprising a support, a pair of opposed face plates laterally mountable thereon, said face plates each having at least one aperture extending therethrough, and mounted core box halves removably fixed to said face plates, respectively, a heating device comprising at least one nozzle carried by a face plate for a combustible air-fuel intermixture, said nozzle being arranged distantly from each core box half discharging a jet through an aperture in each face plate and against said core box half carried thereby, said face plate apertures extending laterally across the width of the core box half associated therewith and defining flame distributing passageways for said jets.

4. In a shell core forming machine comprising a support, a pair of opposed face plates laterally mountable thereon, said face plates each having a plurality of spaced

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apertures extending therethrough, mounted core box halves removably fixed to said face plates, respectively, and a heating device comprising a plurality of spaced nozzles carried by said face plates for a combustible air-fuel intermixture, said nozzles being arranged distantly from core box halves discharging jets through the aperture in said face plates and against said core box halves, said apertures in said face plates constituting fastening connections for joining the core box halves with their associated face plates.

5. A machine for making shell cores from plastic-coated sand comprising a frame including a base and two upstanding supports, spaced apart, a reel comprising a plurality of elongated members rotatably supported between said supports, a pair of face plates carried by said reel, one of said face plates being fixed to said reel and the other movable axially thereof toward and from said relatively fixed plate and defining between said plates a core box station adapted to receive and mount a core box made of separable halves, operating means joined to said reel for displacing said movable face plate axially of said reel, a material retaining receptacle carried by said reel laterally offset from said station and having a discharge aperture opening to said station, and releasable locking means for inhibiting the rotation of said reel and means for maintaining a fixed alignment of said face plates with each other, whereby when an apertured sectional recessed core box is arranged in said station with separable halves secured to said face plates, respectively, and heat is applied to said core box, said locking means for the reel may be released, said reel rotated through approximately a one-half revolution and plastic-covered sand may be discharged from the receptacle through said discharge aperture into said core box to invest the walls of the recesses therein to form a shell core, and said reel may be returned to its original position to return any sand unused in said investment to said receptacle, said face plates each have at least one aperture extending therethrough, said aperture in said face plates, respectively, constituting fastening connections for joining core box halves therewith, and a convection type heater comprising a nozzle for directing a jet of combustible air-fuel intermixture through said apertures in the face plates, respectively, toward the core box station.

6. A machine for making shell cores from plastic-coated sand comprising a frame including a base and two upstanding supports, spaced apart, a reel comprising a plurality of elongated members rotatably supported between said supports, a pair of face plates carried by said reel, one of said face plates being fixed to said reel and the other movable axially thereof toward and from said relatively fixed plate and defining between said plates a core box station adapted to receive and mount a core box made of separable halves, operating means joined to said reel for displacing said movable face plate axially of said reel, a material retaining receptacle carried by said reel laterally offset from said station and having a discharge aperture opening to said station, and releasable locking means for inhibiting the rotation of said reel and means for maintaining a fixed alignment of said face plates with each other, whereby when an apertured sectional recessed core box is arranged in said station with separable halves secured to said face plates, respectively, and heat is applied to said core box, said locking means for the reel may be released, said reel rotated through approximately a one-half revolution and plastic-covered sand may be discharged from the receptacle through said discharge aperture into said core box to invest the walls of the recesses therein to form a shell core, and said reel may be returned to its original position to return any sand unused in said investment to said receptacle, said face plates each have at least one aperture extending therethrough, said aperture in said face plates, respectively, constituting fastening connections for joining core box halves therewith, and a convection type heater

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comprising at least one nozzle for directing a combustible air-fuel intermixture through an aperture in a face plate toward the core box station, said face plate apertures extending laterally across the width of said station and defining flame distributing passageways.

7. A machine for making shell cores from plastic-coated sand comprising a frame including a base and two upstanding supports, spaced apart, a reel comprising a plurality of elongated members rotatably supported between said supports, a pair of face plates carried by said reel, one of said face plates being fixed to said reel and the other movable axially thereof toward and from said relatively fixed plate and defining between said plates a core box station adapted to receive and mount a core box made of separable halves, operating means joined to said reel for displacing said movable face plate axially of said reel, a material retaining receptacle carried by said reel laterally offset from said station and having a discharge aperture opening to said station, and releasable locking means for inhibiting the rotation of said reel and means for maintaining a fixed alignment of said face plates with each other, whereby when an apertured sectional recessed core box is arranged in said station with separable halves secured to said face plates, respectively, and heat is applied to said core box, said locking means for the reel may be released, said reel rotated through approximately a one-half revolution and plastic-covered sand may be discharged from the receptacle through said discharge aperture into said core box to invest the walls of the recesses therein to form a shell core, and said reel may be returned to its original position to return any sand unused in said investment to said receptacle, said face plates each have at least one aperture extending therethrough, said apertures in said face plates, respectively, constituting fastening connections for joining core box halves therewith, and a convection type heater comprising a plurality of nozzles for directing jets of a combustible air-fuel intermixture through said apertures in the face plates toward the core box station, said face plate apertures extending laterally across the width of said station and defining flame distributing passageways.

8. A machine for making shell cores from plastic-coated sand comprising a frame including a base and two upstanding supports, spaced apart, a reel comprising a plurality of elongated members rotatably supported between said supports, a pair of face plates carried by said reel, one of said face plates being fixed to said reel and the other movable axially thereof toward and from said relatively fixed plate and defining between said plates a core box station adapted to receive and mount a core box made of separable halves, operating means joined to said reel for displacing said movable face plate axially of said reel, a material retaining receptacle carried by said reel laterally offset from said station and having a discharge aperture opening to said station, and releasable locking means for inhibiting the rotation of said reel and means for maintaining a fixed alignment of said face plates with each other, whereby when an apertured sectional recessed core box is arranged in said station with separable halves secured to said face plates, respectively, and heat is applied to said core box, said locking means for the reel may be released, said reel rotated through approximately a one-half revolution and plastic-covered sand may be discharged from the receptacle through said discharge aperture into said core box to invest the walls of the recesses therein to form a shell core, and said reel may be returned to its original position to return any sand unused in said investment to said receptacle, said face plates each have a plurality of spaced apertures extending therethrough, said apertures in said face plates, respectively, constituting fastening connections for joining core box halves therewith, and a heating device comprising a plurality of nozzles for directing jets of a combustible air-fuel intermixture through

said plural apertures in the face plates, respectively, toward the core box station.

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