Aug. 27, 1963 R. W. CALLENDER ETAL 3,101,514

SINTERED POWDER METAL MOLD

Filed Dec. 4, 1961

Fig. 1.

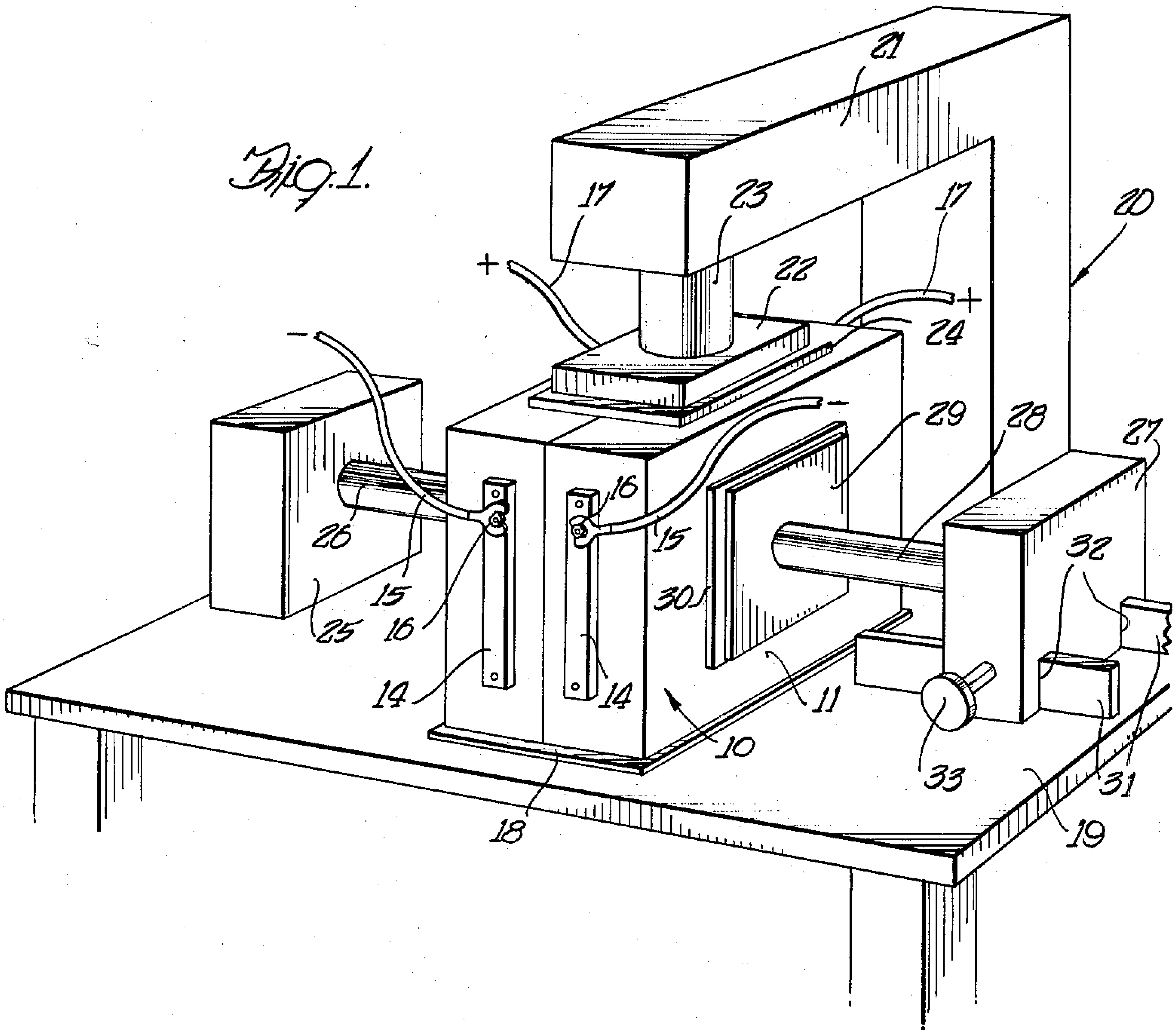
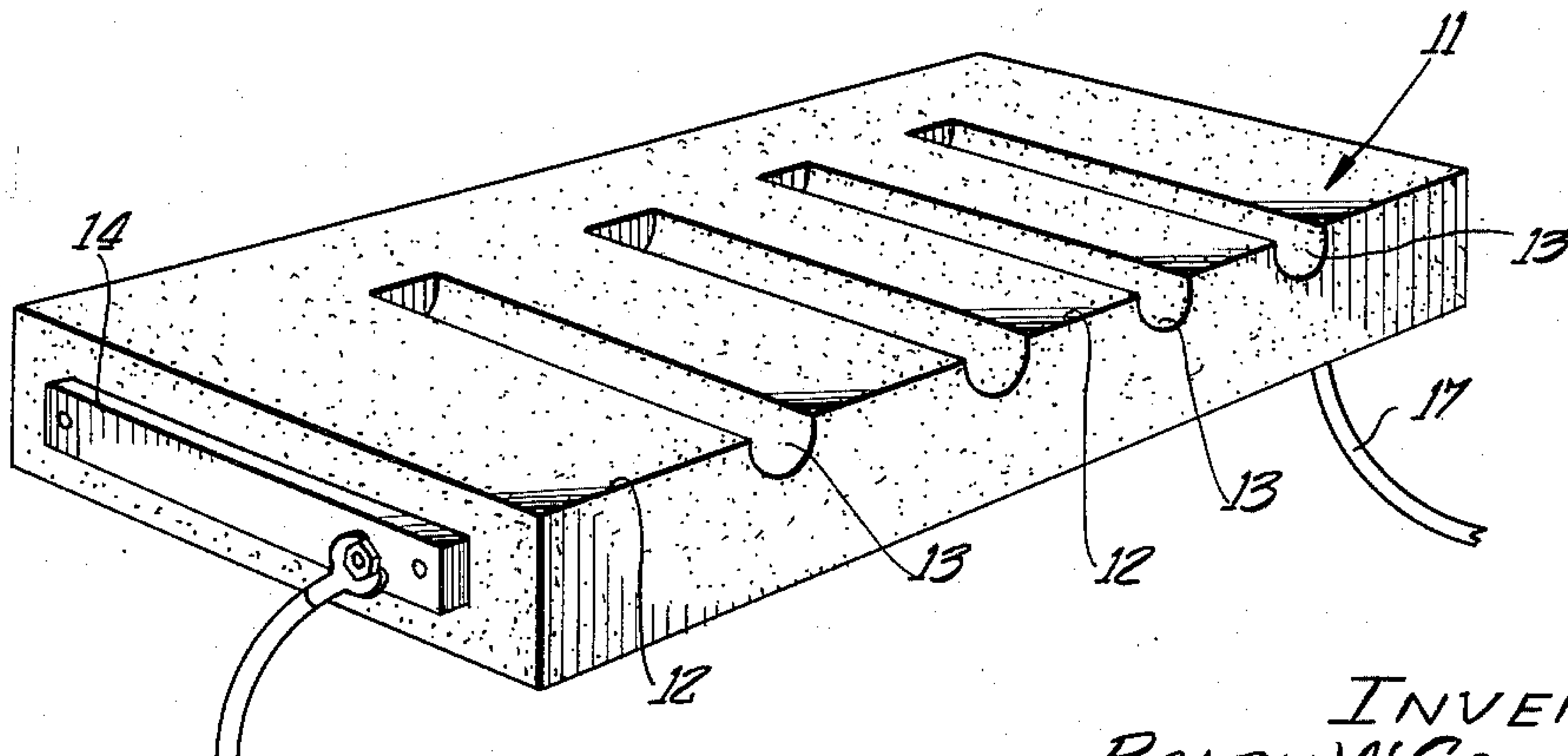


Fig. 2.



INVENTORS
RALPH W. CALLENDER
HAROLD R. BIEHL

ATTORNEY

United States Patent Office 3,101,514
Patented Aug. 27, 1963

3,101,514
SINTERED POWDER METAL MOLD
Ralph W. Callender, Hinsdale, and Harold R. Biehl, Lake Villa, Ill., assignors to International Harvester Company, Chicago, Ill., a corporation of New Jersey
Filed Dec. 4, 1961, Ser. No. 157,871
3 Claims. (Cl. 22—10)

This invention relates to a sintered powdered metal mold and more particularly to a powdered metal mold used in connection with the pressure blowing of cores. This application is a continuation-in-part of applicants' application Serial No. 744,962, now abandoned, filed June 27, 1958.

It is a prime object of this invention to provide an improved mold used in connection with the pressure blowing of cores, the said mold being of a permeable type so as to provide for the release of gases incident to the curing of the cores.

A still further object is the provision of an improved core box for producing cured shell mold cores, the said core box including improved provisions whereby the said cores may be cured immediately after the cores have been blown into the box.

A still further object is to provide an improved core box assembly particularly adapted for use in connection with blowing of shell mold cores wherein the cores consist of a resin-sand mixture which upon heating sets and forms a hardened core, the said core box being adapted to respond to an electrical current for heating the core box, thus setting the blown cores, immediately after a core blowing operation.

A still further object is the provision of an improved core box made of a sintered powdered metal material, the said box having a porous and permeable construction whereupon the box has a good electrical resistivity so that upon the application of an electrical current to the box, the box heats by resistance and therefore cores which are blown into the box are immediately cured after the blowing operation.

A still further object is the provision of an improved process of constructing a powdered metal core box.

Another object is to provide an improved core box constructed of a sintered metal powder, said box having a porous permeable character including particles of copper infiltrated throughout to provide increased strength.

These and further objects wil become more readily apparent from a reading of the description when examined in connection with the accompanying sheet of drawings.

In the drawing:

FIGURE 1 is a perspective view of an improved core box supported on a blowing machine for blowing shell mold cores; and

FIGURE 2 is a perspective view of a one-half portion of a core box assembly.

In FIGURE 1, a mold is generally designated by the reference character **10**. The mold **10** comprises a pair of mold sections or half molds **11**, one of said half molds **11** being shown in FIGURE 2. Each mold section **11** comprises a parting face **12** having a plurality of recesses or cavities **13**. The mold sections **11** are unique in that they are manufactured from metal powder, which may be iron, suitably sintered by conventional powdered metal sintering methods. In addition the mold section **11** includes a generally porous structure which gives the mold a high permeability. In the art of powder metallurgy the porosity of the sintered powder metal is conventional. This porosity is particularly advantageous and unique in a mold box or core mold.

As indicated, a copper junction strip **14** is connected at the forward ends of each mold section **11**. Similarly,

though not shown, a copper junction strip is connected to the rear of each of the mold sections **11**. Negative leads or wires **15** are connected to the copper junction strips **14** as indicated at **16**. Similarly, positive leads or wires **17** are connected to the copper junction strips which are secured to the rear of the mold sections **11**. As indicated in FIGURE 1, the mold **10** is suitably supported on an electrical insulating plate **18** which in turn is supported on a table **19**.

A core blower **20** is mounted on the table **19**, the said core blower **20** including a support **21** having a blowhead **22** which is connected to a conduit **23**. The core blower **20** may be of conventional construction which is adapted to blow sand under high pressures through the blowhead **22** into the core mold **10** supported beneath the blowhead **22**.

The blowhead **22** may be suitably adjusted in a vertical direction and when the mold **10** is positioned in place the blowhead **22** may be supported over the upper ends of the mold sections **11** as indicated.

The mold **10** is securely positioned on the table **19** and the blowhead **22** is securely fastened on top of an insulating plate **24** which electrically insulates the mold **10** from the blowhead **22**. The insulating plate **24** may be suitably apertured (not shown) so that the blowhead **22** may be free to blow sand into the mold **10**.

A stationary clamp member **25** is positioned on one side of the table **19**. A supporting rod **26** projects laterally from the stationary clamp member **25** in the direction of the mold **10**. As indicated in FIGURE 1, a movable clamp member is designated at **27**. This clamp member **27** has connected thereto a rod **28** which in turn is rigidly connected to a clamp plate **29**. The clamp plate **29** engages an electrical insulating pad **30** which electrically insulates the movable clamp member **27** from the mold **10**. The clamp member **27** is movable upon guide rails **31**, the said clamp member including laterally spaced slots each of which straddles one of the guide rails **31**. A clamping screw **33** extends through one side of the clamp member **27** and is adapted to engage one of the rails **31** to secure the said clamp member against longitudinal movement with respect to one of the guide rails **31**. The rod **26** also has a suitable clamp plate which is adapted to engage an insulating pad similar to the pad **30**, the latter pad and clamp plate not being shown in FIGURE 1.

Thus by positioning the mold sections **10** in upright and adjacent contiguous position on the table **19** as indicated in FIGURE 1, the said mold sections **11** may be firmly secured together with their parting faces in contiguous relation by means of the movable clamping mechanism **27**. In this position the recesses or cavities **13** are in complemental relation forming a plurality of cavities or mold chambers. Since the mold sections **11** are tightly held against each other, mold sand can be blown into the cavities through the blowhead **22** which is brought tightly downwardly into engagement with the insulating plate **24**. Thus the mold is now in position for receiving the core sand mixture.

The core sand mixture may consist of a suitable resin and a fine sand which is mixed together in the same proportions as the well-known shell mold mixtures. This sand-resin mixture is then blown into the cavities formed by the complemental recesses **13**.

The electrical wires **15** and **17** are suitably connected to a source of electrical energy where upon current flowing through the wires **17** the powdered metal mold **10** heats by resistance whereupon sufficient heat is generated to cure or bake the sand-resin mixture which has been blown into the cavities. This heating effectuates curing of the shell mold cores. Incident to the heating gases are liberated from the shell mold cores and these gases are free to escape through the porous construction of the mold sections **11**. Thus by virtue of the high permeability of the mold sections **11**, the gases are easily liberated from the mold without any further action on the part of the operator.

Thus it can be seen that the powdered metal mold is advantageous in the core blowing operation and by virtue of the natural resistance of the mold to the electrical current, heating and curing of the sand cores can be accomplished without moving the mold to a separate furnace for heating. Thus a quick heating and curing operation occurs immediately after the blowing of the cores. The metal powder which is utilized may be of iron, though other metal powders resulting in permeability and porosity may be utilized.

An example of the iron metal power composition utilized contained by weight is as follows:

	Percent
Fe total	98.8
H_2 loss	.30
C	.04
SiO_2	.10
S	.007
P	.010

The density of this powder was 2.35–2.45 g./cc. flow (in Hall flow meter)—30 seconds.

The sieve analysis of the powder with U.S. Tyler mesh was as follows:

	Percent
+100	.1
+150	7.0
+200	22.0
+250	17.0
+325	27.0
−325	27.0

In order to secure increased strength it is also desirable to include a certain quantity of copper powder, the copper being finely and widely dispersed throughout the sintered powder metal structure. Thus a copper powder can be intermingled with the mixture in the manufacture of the mold. This mixture will not destroy the qualities of porosity and permeability.

The steps of making the powdered metal molds consists of shaping a pattern in the usual manner. The pattern may be shaped on a metal plate and in turn also may be constructed of metal. The pattern may be placed in a suitable flask or box and the metal powder may be poured into the box over the pattern to completely cover the same. The metal powder used, as indicated above, may be iron or other similar powders. In addition, a porosity forming material may be included in the powder in order to volatilize during sintering whereby a desired degree of interlocking porosity is accomplished in the finished product. Further, a certain quantity of cooper powder may be utilized. The copper powder may be infiltrated into the material after sintering and a percentage by weight of 5% to 15% is utilized. After the powder mixture is placed in the box over the pattern the box may then be placed in a sintering furnace and a sintering operation is completed. The sintering temperature was one hour at 1900° F. After sintering the density of the mold was 2.63 g./cc. with a porosity of 60%. After the box is removed from the furnace the powder metal mold is then removed from the pattern and the strips **14** may be applied. The electrical resistivity is determined as follows:

The stable value of resistance for a sintered iron bar 12.5 inches long and 1 sq. in. cross sectional area is 0.003988 ohm. By applying 180 amperes to the bar the temperature will level off at about 550° F.

This temperature of the mold was considered ideal for shell mold cores. Thus a powdered metal mold box section can be quickly and easily formed, the said assembled mold consisting of two of the sections, providing a complete mold, core, or pattern box having the desired cavities for making the cores. Certain terminology is conventional in the art of powder metallurgy. A.S.T.M. Designation B243–55 gives the following definitions used herein:

Intercommunicating porosity.—That type of porosity in a sintered compact in which the pores are connected so that fluid may pass from one to the other completely through the compact. The term is shortened simply to porosity in the claims.

Pore forming material.— A substance included in a powder mixture which volatilizes during sintering and thereby produces a desired kind and degree of porosity in the finished compact.

Sintering.—The bonding of adjacent surfaces of particles in a mass of powder, or a compact, by heating. The terms "core box" and "mold box" have been used throughout the description and claims. The invention is not limited to the specific application stated and is applicable to "pattern boxes" and any arrangements wherein an enclosure is provided to contain a cavity for producing molds.

Thus it is believed that an improved process and article of manufacture has been described which will completely and efficiently accomplish the desired objects of the invention. It must be realized that changes and modifications may be made which do not depart from the spirit of the invention as defined in the appended claims:

What is claimed is:

1. A pressure molding assembly comprising a pair of separable mold members having opposed parting faces, at least one of said mold members including a cavity in its parting face and defining in an assembled position with the faces in adjacent relation a molding chamber, a source of mold material under pressure, said chamber being adapted to be placed into communication with said source of mold material under pressure, each of said mold members being constructed of a sintered powdered metal having a generally porous structure to provide permeability, said powdered metal mold members also having copper metal dispersed throughout said porous structure, said mold members having a high electrical resistivity, and an electrical connector connected to each mold member and being adapted during connection with an electrical source to direct current through said mold members thereby heating the same whereby mold material within said cavity is heated and cured, and gases incident to said curing are released through said porous mold members.

2. A molding assembly comprising a pair of separable mold members having opposed parting faces, at least one of said mold members including a cavity in its parting face and defining in an assembled position with the faces in adjacent relation a molding chamber, a source of mold material under pressure, said chamber being adapted to be placed into communication with said source of mold material, each of said mold members being constructed of a sintered powdered metal having a generally porous structure to provide permeability, said powdered metal mold members also having high electrical resistivity, and an electrical connector connected to each mold member and being adapted during connection with an electrical source to pass a current through said mold members thereby heating the same whereby mold material within said cavity is heated and cured, and gases incident to said curing are released through said porous mold members.

3. A molding assembly comprising a pair of separable mold members having opposed parting faces, at least one of said mold members including a cavity in its parting face and defining in an assembled position with the faces in adjacent relation a molding chamber, a source of mold material under pressure, said chamber being adapted to be placed into communication with said source of mold material under pressure, each of said mold members being constructed of a sintered powdered metal having a generally porous structure to provide permeability, said

mold members having high electrical resistivity, and electrical means connected to each mold member and being adapted during connection with an electrical source to pass a current through said mold members thereby heating the same whereby mold material within said cavity is heated and cured, and gases incident to said curing are released through said porous mold members.

References Cited in the file of this patent

UNITED STATES PATENTS

575,115	Hunt	Jan. 12, 1897
2,852,818	Shallenberger et al.	Sept. 23, 1958

FOREIGN PATENTS

330,018	Great Britain	June 5, 1930