(No Model.) 3 Sheets—Sheet 1.

J. ILLINGWORTH.

INGOT FORMING APPARATUS.

No. 382,427. Patented May 8, 1888.

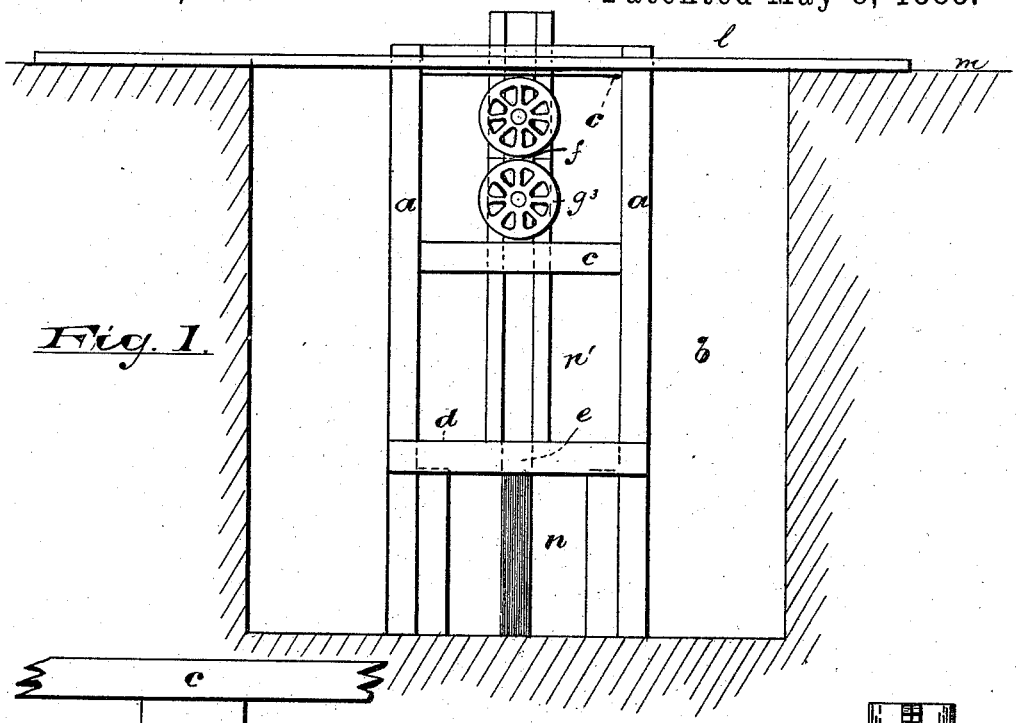


Fig. 1.

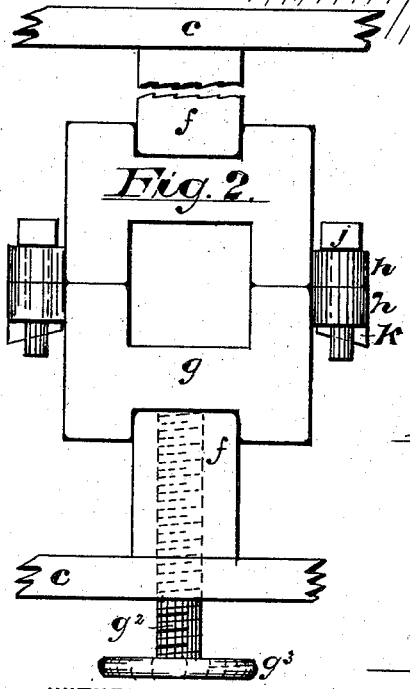


Fig. 2.

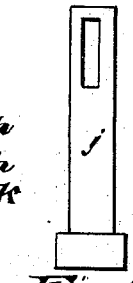


Fig. 4.

Fig. 5.

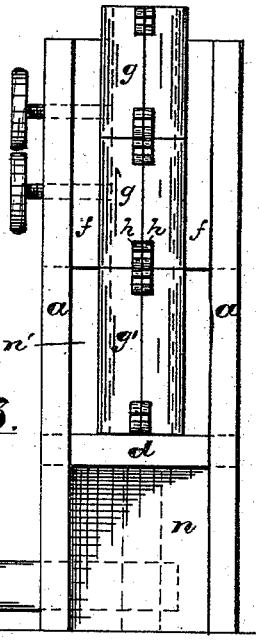
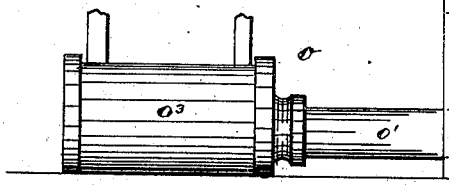


Fig. 3.



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(No Model.) 3 Sheets—Sheet 2.

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INGOT FORMING APPARATUS.

No. 382,427. Patented May 8, 1888.

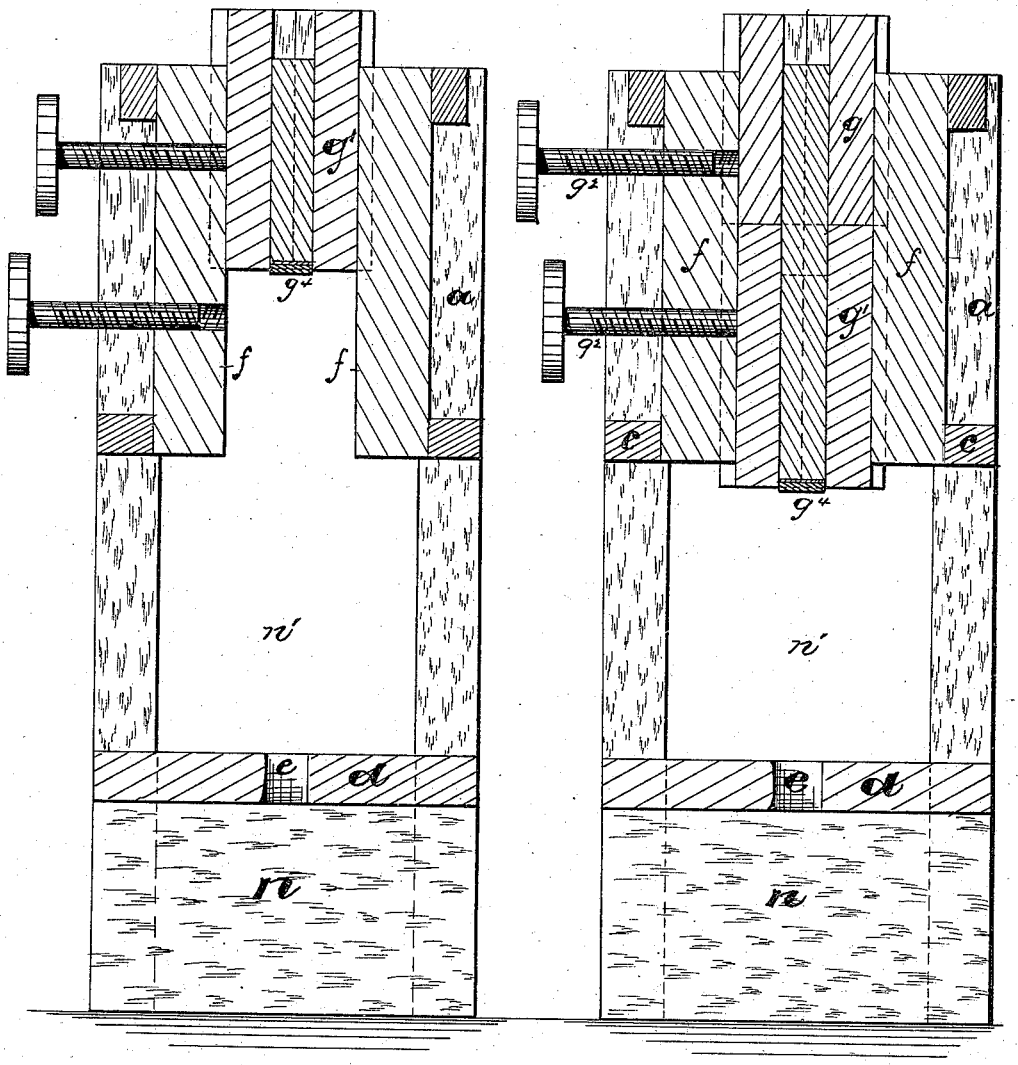

Fig. 6. Fig. 7.

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(No Model.) 3 Sheets—Sheet 3.

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INGOT FORMING APPARATUS.

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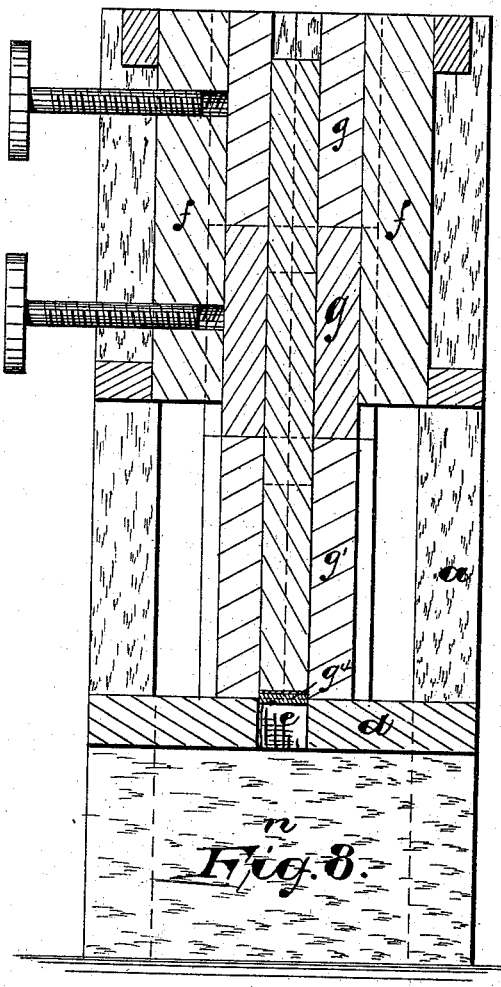

Fig. 8.

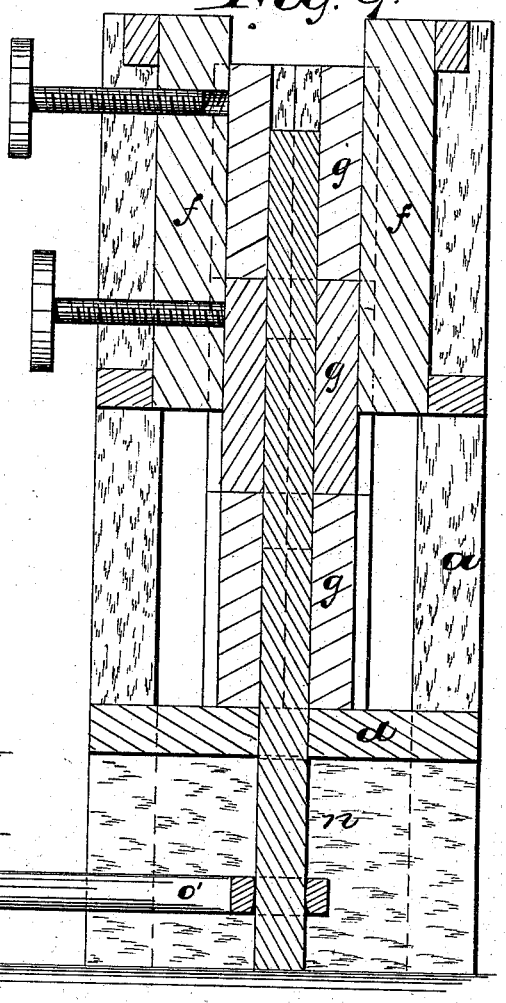

Fig. 9.

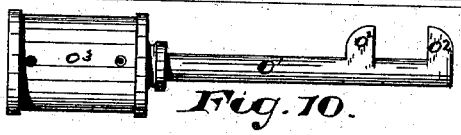

Fig. 10.

WITNESSES:

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UNITED STATES PATENT OFFICE.

JOHN ILLINGWORTH, OF NEWARK, NEW JERSEY.

INGOT-FORMING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 382,427, dated May 8, 1888.

Application filed January 4, 1888. Serial No. 259,774. (No model.)

To all whom it may concern:

Be it known that I, JOHN ILLINGWORTH, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Ingot-Forming Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates more particularly to certain improvements in that class of apparatus for casting ingots illustrated by me in pending applications, and particularly the one illustrated in application numbered 241,163, the object of this invention being primarily to prevent piping in the process of casting steel ingots.

The particular or more restricted objects of the invention are to reduce the cost of casting, to carry on the process more conveniently and effectively, and to reduce the cost of the plant required for carrying on the process.

The invention consists in the improved apparatus for casting ingots, and in the arrangements and combinations of parts thereof, substantially as will be hereinafter described and claimed.

Referring to the accompanying drawings, embraced in three sheets, in which like letters of reference indicate corresponding parts in each of the several figures, Figure 1, Sheet 1, is an elevation of a central frame-work, which may be built in a "pit" of the steel-works, which said frame-work is adapted to receive mold-sections, and showing said mold-sections in place therein. Fig. 2 is a detail plan of the mold-sections and parts of said frame. Fig. 3 is an elevation showing the side of said frame and mold or portions thereof, and showing the relation of certain breaking-off or severing mechanism to the same. Fig. 4 is a detail of a bolt adapted to be keyed to the mold to hold certain sections thereof together, and Fig. 5 is a plan of a key which may be employed with said bolt. Fig. 6, Sheet 2, is a central vertical section of the apparatus, illustrating the first step in the process of casting. Fig. 7 is a section illustrating a second step. Fig. 8, Sheet 3, illustrates a third step; and Fig. 9, a fourth step, and showing the ingot in a position to engage the severing mechanism. Fig. 10 illustrates the construction of a hydraulic device for severing the lower part of the ingot from the body thereof in one of the final stages of the process.

In said drawings, *a a* indicate certain studs arranged in the pit *b*, and which may form the four corners of an iron frame-work, and be held in proper relation to one another by cross bars or pieces *c c*, in any suitable manner. At a point above the bottom of the pit the said frame is provided with a suitable flooring, *d*, the distance between the flooring and the bottom of the pit being about two feet, or about the length of the desired ingot. Said flooring may be, and preferably is, of sufficient area to allow a workman to stand thereon and to attend to certain operations in the process of casting. Said flooring is perforated at about the center or in line with the ingot being cast thereover, the perforation *e* being of about the dimensions of the ingot in cross-section, but sufficiently larger to allow the ingot to pass readily through the same without forcing, but not large enough to allow the mold-sections to pass through the said flooring, the said flooring thus serving as a stop for said mold-sections, but not for the ingot.

In the frame-work above the flooring are arranged suitable vertical guideways, *f*, or tracks, in or between which mold-sections *g g'* may slide downward in accordance with certain steps in the process hereinafter described. Said guideways terminate short of the flooring *d*, to allow the lower mold-sections to be stripped from the ingot before the latter passes through to the chamber *n*, a stripping-space, *n'*, being thus formed. Said guideways are provided with holders g^2, which may be large set-screws provided with hand-wheels g^3, said holders being adapted to prevent the downward movement of the mold-sections, so that they will not fall by gravity when the lower one of the series is removed. Said holders may be in a series to hold the mold-sections at various points in the frame. Said mold-sections are made in half-sections or parts, about as indicated, and are adapted to be separated from one another when the same are being stripped from the ingot. They are

provided with ears *h*, having open slots, into which bolts *j*, with wedge-like keys *k*, are inserted to hold the parts together, substantially as in the manner illustrated in Figs. 2, 3, 4, and 5. Said mold-sections are bottomless, so that when placed in a series one upon the other, as indicated in Fig. 6, the chamber for the cast metal will be a continuous one, extending through the series. The joints between the mold sections may or may not be packed with clay or other suitable material.

I may employ in beginning the casting process a plug or dummy for closing the lower end of the ingot-chamber. In subsequent operations the ingots or ingot portion previously cast serves as a dummy or bottom of the mold for the next casting.

The lowest of the mold-sections (marked *g'*) which is used at the commencement of the process is longer than those employed subsequently, as will be clearly apparent in Fig. 3, for a purpose that will be clearly brought out in the description of the process.

The top of the mold and the frame-work *c c* is about on a level with the flooring or yard *m*, adjacent to the pit. An access to the top of the mold is gained by means of suitable bridging or flooring, *l*, which extends from said flooring to and around said molds. Thus an attendant is allowed to pour the molten metal into the elevated end of the mold. Said flooring may be covered with sheet-iron and soil, whereby any molten metal falling from the ladle is prevented from dropping upon the men at the lower end of the mold within the pit.

The sides of the mold are provided with a longitudinal recess to receive the rails or tracks *f*, although the said rails may be recessed to receive the mold or projection thereon.

In operating with the mold sections and cooperating mechanisms in accordance with the process, I first hold the mold-section *g'* by means of set-screws or holders g^2, as in Fig. 6, so that the open upper end thereof will be about on a level with or a little above the flooring *l*. The bottom of the mold is suitably plugged, as at g^4. The said mold-section is partly filled with metal to an extent equal to or about equal to the length of the desired final ingot or ingot-section or part that is equal to the length of the mold *g*, the upper part of the mold-section chamber remaining empty to an extent equal to the thickness of the flooring *d*. The mold-section *g'* is then allowed to lower to the position illustrated in Fig. 7 by removing the holding mechanism from engagement therewith until room is given for a second mold-section above the first, when the lower section is stopped in its gravitation by the second lower holder, g^2, (shown in Figs. 1, 3, and 6,) and a second mold-section is inserted in the space thus provided. The lower part of the second mold-section and the chamber remaining in the first is then filled with a second pouring of metal, which makes a contact with the first casting, now partly solid, so that as the first said casting continues to solidify the upper liquid metal is drawn into the chamber or "pipe" that would otherwise have been formed, and the ingot or the series of ingot parts are made solid at and near the joining. The holding devices are again withdrawn from the mold and the series is allowed to gravitate again until stopped by the flooring or stop *d*, as in Fig. 8, (if the series is to consist of three mold-sections,) and a third mold-section is placed at the top to receive the molten metal. By this time the metal first cast is solid, or sufficiently so to allow the first mold-section to be stripped from the ingot. The attendant then removes the keys *k* and bolts *j* from the ears *h*, and the parts of the lowest mold-sections are removed from the ingot, the ingot then being free to pass through the perforation *e* in the flooring to the chamber *n* beneath, as in Fig. 9. After the ingot is free of the flooring or fulcrumal bearing and the surrounding mold, the plug g^4—which may be separated from the ingot by asbestus or clay—may drop away from the ingot, or the said plug may remain connected with the ingot and be removed subsequently in any suitable or ordinary manner. Before removing the said lowest mold section the upper sections are secured in place by the holders g^2, as will be understood. The upper part of the second mold and lower part of the third mold having been filled with molten metal, and the first casting bared, the holders are again withdrawn and the series of sections with the series of castings therein again gravitate until again stopped by the flooring *d*, the bared portion of the ingot now projecting into the chamber *n*. While I prefer the use of the long mold *g'*, to enable me to bring the joint formed when the flow of metal is stopped below the flooring, such mold may be dispensed with and all the molds be of a given length. In that case the ingot may be severed from the body-casting at any point therein. The joint is not or need not be of such a nature as to vitiate the ingot. However, in practice, I prefer that the joint be brought at, or approximately at, the fulcrumal bearings of the flooring or stop *d*. The bared portion is then severed by means of a hydraulic device, *o*, (shown in Figs. 3, 6, and 7,) which has been shown and claimed specifically in a prior pending application, No. 245,992; but the severing operation can be carried on by any process or mechanism, though that shown is preferred. Such preferred mechanism consists of a piston, *o'*, having arms o^2 o^2, which engage opposite sides of the ingot, and a suitable hydraulic cylinder, o^3, to give reciprocating movement to the piston and the ingot connected therewith, so that the latter is broken off at the flooring *d*. Said flooring serves or may serve as a fulcrum or holder for giving the ingot firmness to resist the said motion, so that the upper parts of the casting may not be affected. The joint in the ingot—should one be formed between the first casting and the second one—

is brought to the under side of the flooring by making the second casting in the operation above described project into the first mold, so that said joint is brought or formed below the bottom of the second mold-section, as will be evident. Thus when the first section, g', is stripped from the ingot, the joint will be allowed to pass through the perforation e, and when the lowering is stopped by the second mold-section engaging the flooring the said joint will lie on a line with the under side of the flooring d, where it serves to make more easy the operation of severing. Because the metal introduced into the mold-sections at a pouring is about equal to the capacity of the smaller mold-sections, and because the metal of the subsequent pourings passes into the chambers formed in the lower mold-sections, a chamber equal to the thickness of the flooring is formed in each repetition of casting.

The operation above described of allowing the mold-sections to lower with the ingot therein, introducing an upper mold-section and stripping the ingot of the lower mold-section, and then allowing the bared ingot to drop through the perforation e into the chamber n, and there be broken off or severed into parts, may be repeated until all the metal of a "heat" is consumed.

The long mold-section, g', is not, or at least may not, be used again in the continuous operations, the smaller mold sections, g, being all of uniform size, and alone used after the long section is stripped from the casting. The mold-sections may be arranged between the tracks or ways by means of a crane, or by hand-power alone.

By the automatic lowering of the ingot and mold sections by their own gravity the use of means for lowering—such as the elevator described in my prior application—is avoided, and not only is the cost of the plant reduced materially, but I accomplish the results with greater facility, gaining much time which would otherwise be lost in manipulating the elevator, inasmuch as the metal hardens with greater rapidity.

Having thus described the invention, what I claim as new is—

1. In an ingot apparatus, the combination, with a frame-work having stripping-spaces n' and a severing chamber, of a series of mold-sections, and holders adapted to be withdrawn from said sections to allow said sections to gravitate, and means for severing the ingot, said parts being arranged and combined substantially as set forth.

2. The combination, with a series of ingot-mold sections arranged vertically in line and adapted to be stripped from the ingot, of a stop, d, for limiting the downward movement of the mold without limiting the movement of the ingot, and means for severing the stripped ingot, substantially as set forth.

3. In an ingot apparatus, the combination, with a frame having suitable ways, f, and an apertured stop or flooring, d, of a series of molds and means for severing the ingot, substantially as and for the purposes set forth.

4. In an ingot apparatus, the combination, with a suitable frame having suitable ways, f, a fulcrum, and a mold-stop adapted to serve as a holder or bearing in severing the ingot and for limiting the downward progress of the mold, of said mold and means for severing the ingot, substantially as set forth.

5. In combination, in an ingot apparatus, a frame having holders for preventing downward movement, and a stripping-space, a stop, and means for severing said lower portion, substantially as set forth.

6. The combination, with a series of ingot-mold sections formed in part sections or halves, of a holder to retain certain upper sections of said series in an elevated position, while certain lower sections of said series are being stripped, and means for severing the bared portion of the ingot from the body portion, substantially as set forth.

7. In combination, a frame having a stripping-space and a severing-chamber below said stripping-space, suitable ways, f, for mold-sections, holders g^2, perforated flooring d, and severing means, substantially as set forth.

8. In combination, a frame, suitable ways, f, set-screws g^2, and a perforated flooring serving as a stop for limiting the gravitation of the mold-sections and as a passage for the ingot, and means for severing the ingot, substantially as and for the purposes set forth.

9. In an ingot-mold, the combination of a series of short mold-sections, a long mold-section, and a frame having a flooring adapted to allow the downward progress of the ingot but not the said mold-sections, substantially as set forth.

10. In an ingot apparatus, in combination, a frame having holders, a series of mold-sections adapted to be stripped from the casting and free to drop automatically into a stripping-space into engagement with a flooring or stop, and means for severing the stripped portion of the ingot, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 24th day of December, 1887.

JOHN ILLINGWORTH.

Witnesses:
CHARLES H. PELL,
OSCAR A. MICHEL.