Jan. 10, 1939. I. O'ROURKE 2,143,449

APPARATUS FOR MAKING DUCTS

Filed Aug. 1, 1936 2 Sheets-Sheet 1

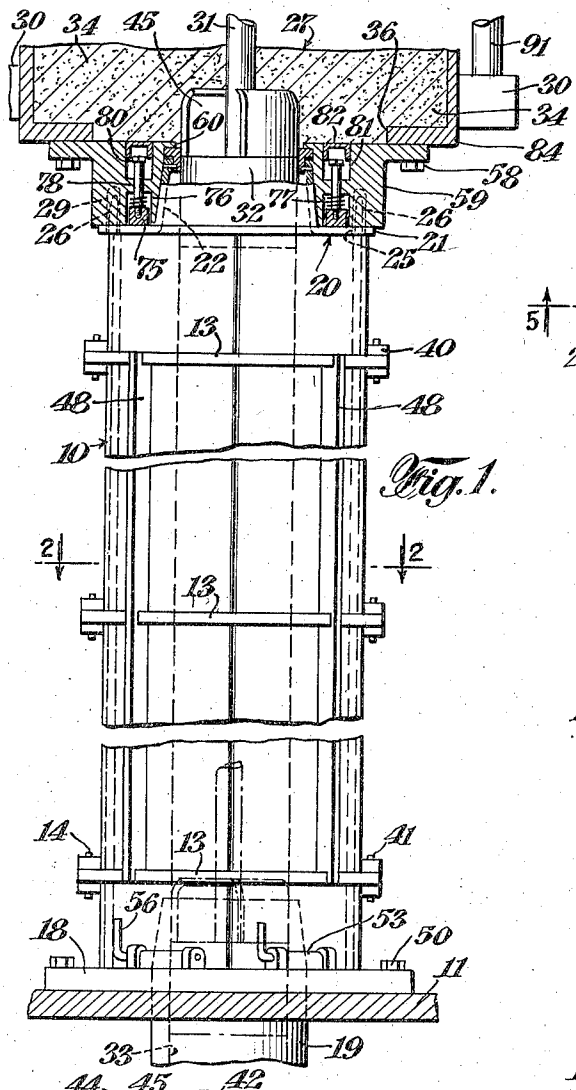


Fig. 1.

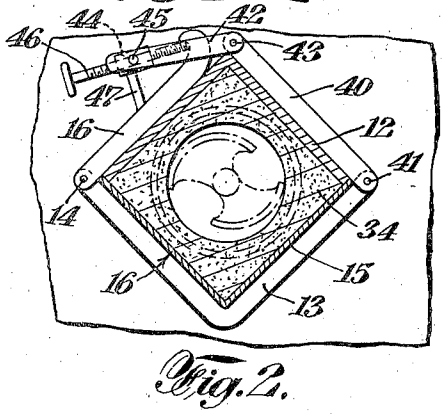


Fig. 2.

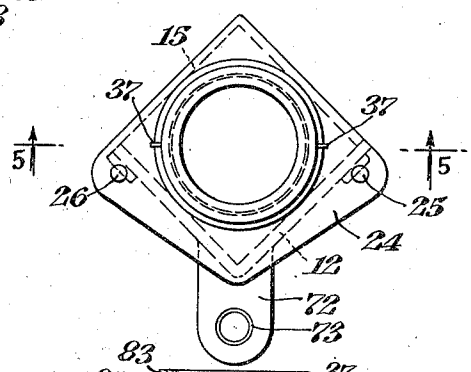


Fig. 4.

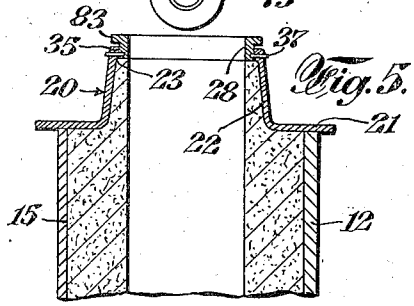


Fig. 5.

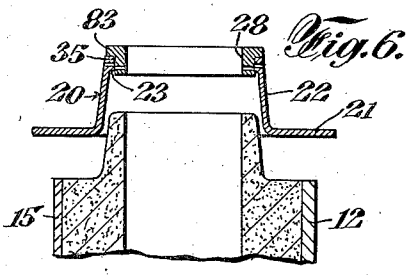


Fig. 6.

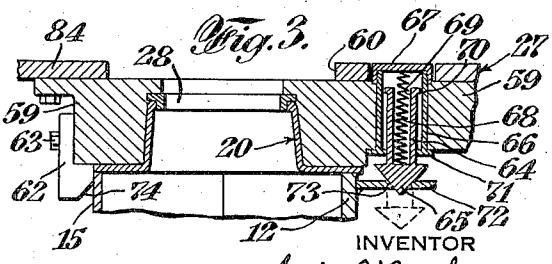


Fig. 3.

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Jan. 10, 1939. I. O'ROURKE 2,143,449

APPARATUS FOR MAKING DUCTS

Filed Aug. 1, 1936 2 Sheets-Sheet 2

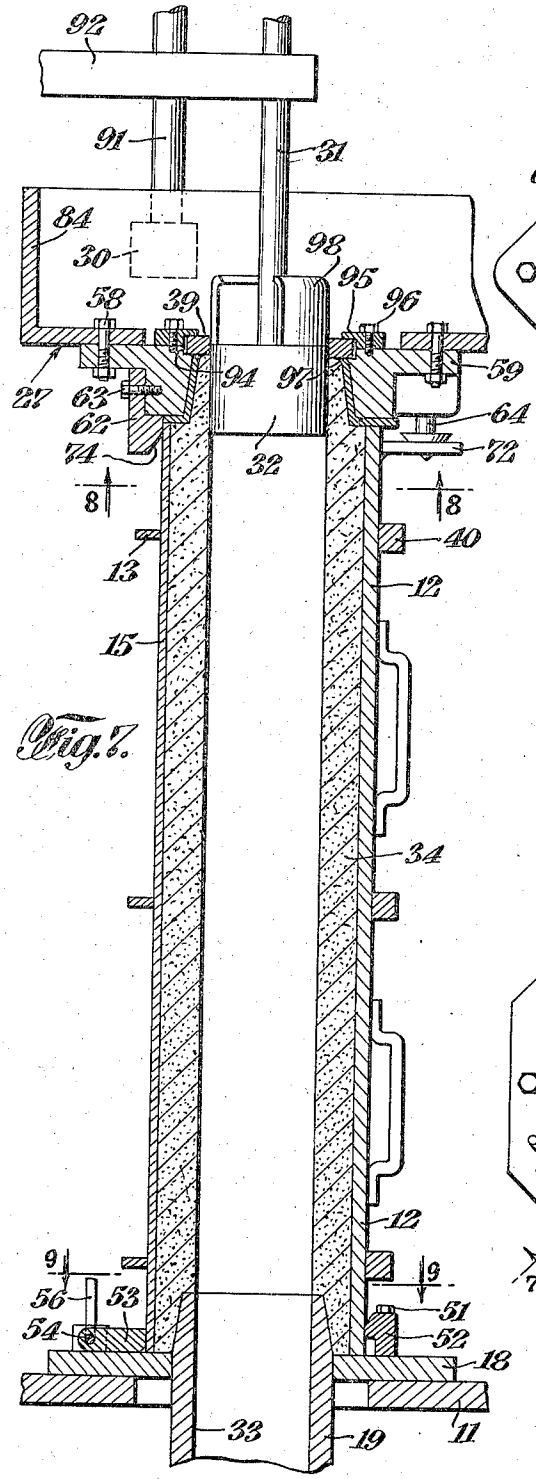


Fig. 7.

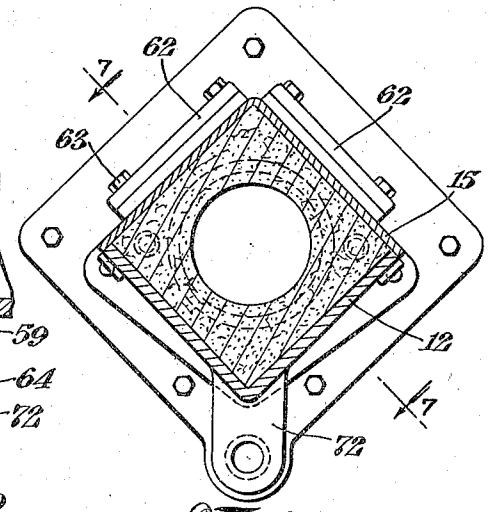


Fig. 8.

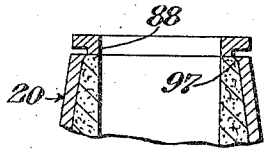


Fig. 10.

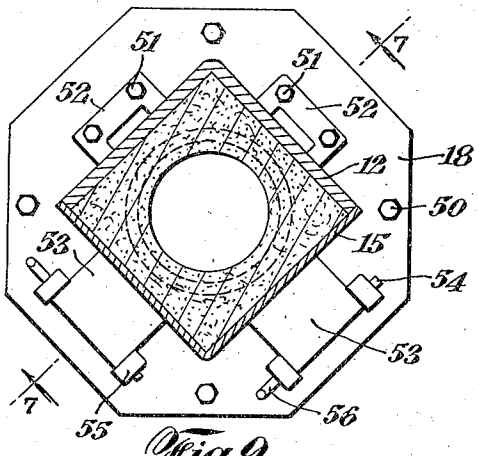


Fig. 9.

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UNITED STATES PATENT OFFICE

2,143,449

APPARATUS FOR MAKING DUCTS

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Application August 1, 1936, Serial No. 93,787

15 Claims. (Cl. 25—36)

This invention relates to apparatus for making ducts from moldable material such as concrete, the term duct being used broadly to cover hollow conduits of any form. This invention relates especially to apparatus for making ducts having male and female ends adapted to permit successive lengths or units to be fitted together.

Concrete ducts have been made heretofore using a vertical mold adapted to form the outside wall of a duct formed within the mold in combination with a core former which in the usual case comprises a former head having an external diameter corresponding to the desired internal diameter of the duct. The former head is usually mounted on a rotatable shaft and is adapted together with the shaft for being raised and lowered during rotation of the former head. In using such apparatus the mold is first placed on a suitable support. The former head is then lowered to the bottom of the mold and concrete is poured into the mold above the former head. By rotating the former head and raising it relatively to the mold the concrete or other moldable material is compacted against the side wall of the mold and the compacted concrete is troweled so as to form a relatively smooth inner surface of the duct. Eventually the former head is moved out of the mold leaving a hollow concrete duct within the mold which can be removed from the mold and taken to storage where the duct is permitted to season until it is strong enough to be shipped to the user.

As aforesaid, ducts are commonly made with male and female ends so that the individual ducts can be fitted together to form a substantially continuous conduit comprising a plurality of units of lesser length, e. g., from five to seven feet in length when the ducts have an external diameter of about 6 to 8 inches.

Sewer pipe is usually made with an outward bell-shaped end so that the internal diameter of the enlarged bell-shaped portion will be substantially the same as the external diameter of the rest of the pipe. Frequently, however, it is desired to eliminate these bell-shaped enlargements. The elimination of the enlargements becomes especially important in installations affording an underground conduit for wires, as in such case it is highly desirable to have the duct occupy as little space as possible and to have the individual ducts performed so as to be of substantially the same external diameter throughout.

When the ducts are made having male and female ends but without the bell-shaped enlargement, the molding of the male and female ends of the ducts involves decreasing the thickness of the wall of the duct at the portions where the male and female ends occur. The manufacture of ducts, e. g., concrete ducts, of the character aforesaid wherein the male and female ends are formed by reducing the thickness of the side wall of the ducts at the portion where the male and female ends occur, presents a serious problem in connection with apparatus of the character hereinabove referred to whereby ducts are molded by means of vertical molds and a former head operable within the mold. Especially great difficulty has heretofore been encountered in making the male end of the duct and it is an object of this invention to afford novel apparatus whereby the male end of the duct can be molded and removed from mold without breakage of the male end of the duct even though the concrete is relatively soft and easily broken.

Features of this invention relate to the mold or die pallet which is used for molding the outside surface of the male end of a concrete duct, for example, and the combination of the die pallet with the mold and with the hopper device which is used for filling the mold with concrete and for holding the upper end of the mold in place. Further features of this invention relate to means whereby the concrete in the male end of the duct can be maintained consolidated while the die pallet is being removed from the mold.

Further purposes, features and advantages of this invention will be apparent in connection with the following description of certain illustrative embodiments of this invention which are shown in the accompanying drawings wherein—

Fig. 1 is a side view partly in section of molding apparatus embodying this invention.

Fig. 2 is a plan view of the apparatus taken on the line 2—2 of Fig. 1.

Fig. 3 is a side sectional view of the upper end of the apparatus shown in Fig. 1, the section being taken at 90° to the sectional portion of Fig. 1.

Fig. 4 is a plan view of the die pallet and mold shown in Fig. 1 with the hopper and core former removed.

Fig. 5 is a side sectional view taken on the line 4—4 of Fig. 4.

Fig. 6 is a view of the upper end of the mold shown in Fig. 5 with the die pallet partially removed.

Fig. 7 is a side sectional view of the molding apparatus including an alternate form of die pallet and hopper casting.

Fig. 8 is a view of the apparatus shown in Fig. 7 taken on the line 8—8 of Fig. 7; Fig. 7 being taken on the line 7—7 of Fig. 8.

Fig. 9 is a view of the apparatus shown in Fig. 7 taken on the line 9—9 of Fig. 7; Fig. 7 being taken on the line 7—7 of Fig. 9.

Fig. 10 is a side sectional detail view of a modified ring for use in loosening the die pallet.

In the apparatus shown in the drawings, a vertical mold is shown which is indicated generally by the reference character 10 and which rests vertically upon a support 11. The mold 10

is adapted to form the outer surface of a duct having a square exterior. Such a duct will be referred to herein as a square duct. The mold 10 comprises two parts. The part 12 is the master section and is V-shaped as shown. The other part 15 is the pallet part and is likewise V-shaped. To maintain the parts 12 and 15 assembled in complementary relation any suitable clamps may be used. For example, as more fully described in my application, Serial No. 93,786, filed August 1, 1936, for Apparatus and method for making ducts (executed on even date herewith), one or more clamping bands (see Figs. 1 and 2) may be used which comprises a V-shaped member 13 to one end of which is attached a hook member 16 by means of hinge 14. At the other end of V-shaped member 13 a link member 40 is attached by hinge 41. A pair of bars 42 are attached to the other end of link member 40 by hinge 43 and between the bars 42 is pivotally secured block 44 by means of pivot pins 45. A threaded rod 46 is in threaded engagement with a threaded bore through block 44 and has its end adapted to be thrust against the end of hook member 16 when the clamping ring is clamped in place. A lug 47 is attached to the hook member 16 and is adapted to maintain block 44 in proper position when the clamping members are in clamping position. When it is desired to release the clamping members all that is necessary is to pull outwardly on the headed end of the rod 46 which permits the hook member 16 and the link 40 to be swung out of the way so that the mold parts 12 and 15 can be separated. In assembling the mold the mold parts 12 and 15 are placed in position and the clamping members are brought into the position shown in Fig. 2. Any number of clamping devices can be used and three or four are ordinarily desirable in connection with molds about 5 to 7 feet long. If desired, a plurality of clamping bands can be spaced from each other and maintained as a unitary clamping device by securing the V-shaped members 13 to bars 48 which extend longitudinally of the mold.

In order to position mold 10 in proper position on the support 11, any suitable means may be used. For example, the device shown in Figs. 1, 7 and 9 may be used which comprises a plate 18 which may be secured to support 11 by any suitable means such as bolts 50. Secured to plate 18 as by means of bolts 51 are stop blocks 52 which are adapted to be abutted against the walls of the master mold section 12. Abutting against the walls of pallet part 15 are a pair of locking lugs 53 which are secured to rod 54 passing through hinge blocks 55 secured to the plate 18. One end of the rod 54 carries a lever arm 56 which can be grasped to rock locking lugs into and out of position for clamping the lower end of the mold in place. In placing the mold in position the locking lugs 53 are rocked up out of the way and the mold is pushed against the stop blocks 52. The locking lugs can then be rocked into the locking position shown in the drawings. The locking lugs are rocked out of the way when it is desired to remove the mold.

While a specific mold has been shown and described for purposes of illustration, it is to be understood that the particular shape of the mold, e. g., square or round, and the number, arrangement and assembly of the mold parts may be varied widely in apparatus of the character herein described.

In referring to the male and female ends of a duct, reference is made to those end parts of the duct at which the male and female portions occur. In order to form the female end of the duct, a suitable former die 19 is used which is insertable through appropriate openings in the support 11 and plate 18. The means used for forming the female end of the duct is to be regarded as optional. If desired, the die 19 can be mounted on suitable means (not shown) whereby the die may be rotated and likewise elevated and lowered through the opening in the support, the die 19 being shown in Figs. 1 and 7 in elevated position.

At the upper end of the mold is the die pallet which is indicated generally by the reference character 20 and which I have called a "top hat". The die pallet includes an annular flat portion 21 which rests on the upper end of the walls of the mold 10 and an outwardly diminishing tapered portion 22 having an opening 35 in the outer end thereof. The tapered portion 22 preferably has a slightly inturned portion 23 adjacent the top thereof. The flat portion 21 includes ears 24 which preferably project substantially beyond the outside of the walls of the mold 10. The ears 24 have holes 25 therein which form a snug but slidable fit with the pins 26 which pins are secured to the upper end of the mold 10 as by being attached in any suitable manner to the master section 12 of the mold. In this manner the die pallet 20 by means outside of the mold is maintained in axial alignment with the mold by being restrained from lateral movement with respect to the mold and is guided so that it can be moved away from the mold 10 only while disposed in substantially the same axial position that the die pallet occupies when resting in contact with the upper end of the mold 10.

Above the mold is a hopper which is indicated generally by the reference character 27 and which can be supplied with concrete or other moldable material from any suitable source not shown. The hopper includes a pan member 84 which has an opening 36 in the bottom thereof. The hopper also includes the member 59 which is secured to the underside of the pan member 84 by any suitable means such as bolts 58. The member 59 may be referred to as a "casting" although it is not necessary that this member be manufactured by a casting process. This casting may be made in one piece with the pan 84, if desired, and in such case the hopper would be made in one piece. The casting member 59 has an opening 60 adapted to discharge moldable material from the hopper into the end of the mold and to register with the opening 35 in said die pallet. While the part 27 is referred to herein as a hopper, it is to be understood that the word "hopper" is applicable to any pan, plate or similar member made in one or a plurality of parts and serving an equivalent function.

The underside of the casting member 59 has recesses 29 therein that, while slidable with reference to the pins 26, preferably fit quite snugly thereover as to cause the upper end of mold 10 to be maintained in accurate alignment with the hopper. The hopper 27 is supported as by brackets 30 attached to rods 91 which are operatively connected to suitable means (not shown) for raising and lowering the hopper 27. The rods 91 may be guided as by bushing bracket 92 attached to some stationary support (not shown). The hopper 27 is adapted to be raised substantially above the upper end of the tapered por-

tion of the pallet 20 so that the mold can be readily assembled and disassembled and brought into cooperative relationship with the hopper 27. While the hopper is illustrated as being raised while the mold remains stationary, the hopper may remain stationary and the mold lowered. In either case, the hopper is to be regarded as moved (or elevated and lowered) into and away from position at the end of the mold. The means used to move the hopper likewise serves to maintain the hopper in position at the end of the mold.

Preferably the support 11 is adapted to be moved laterally with respect to the hopper 27. For example, the support is preferably operatively associated with suitable means (not shown) for moving the support with the mold assembled thereon to one side after the hopper has been moved upwardly away from the mold and after the forming die 19 has been lowered below the underside of the foundation member 11. In this manner the mold can be moved from underneath the hopper so as to facilitate the assembly and disassembly thereof.

In order to facilitate the preliminary alignment of the mold and hopper a guiding means such as that shown in Figs. 3, 4, 7 and 8 may be used. Two blocks 62 are secured to casting member 59 by suitable means such as bolts 63 so as to contact the external surface of the walls of the pallet part 15 of the mold 10. Set in casting member 59 is a resiliently mounted pin 64 having a tapered end 65. The pin 64 slides within sleeve 66 which fits within a hole in the casting member 59. The sleeve 66 is provided with a detachable cap 67 against which is urged one end of an expansible spring 68, the other end of the spring extending into the hollow core 69 of pin 64 to urge it downwardly. The pin is prevented from being expelled from the sleeve 66 by lip 70 striking against the headed part 71 of the sleeve. The headed part 71 of the sleeve and the cap 67 also serve to maintain the sleeve securely in casting member 59. Attached to master mold section 12 as by welding is a centering bracket 72 having a tapered hole 73 therein. When the hopper 27 is elevated above the mold 10 the pin 64 and the tapered end 65 thereof assume the position shown in dotted lines in Fig. 3. When it is desired to bring the mold 10 into alignment with the hopper 27 the pallet part 15 of mold 10 is merely pushed against the blocks 62 which preferably have tapered end walls 74 to facilitate the preliminary alignment. When this is done the tapered end 65 of pin 64 partially enters the hole 73 in bracket 72 and by pressure contact therewith holds the mold in alignment with the hopper. The hopper can now be lowered throughout a substantial distance to position at the end of the mold and the pin 64 will be pushed backwardly to the position shown in solid lines in Fig. 3 while the end 65 remains in pressure contact with bracket 72. In this manner the hopper and die are held in alignment even though somewhat separated so that upon completing the lowering of the hopper into position at the top of the mold 10 the pins 26 will slide into the recesses 29 without jamming. In this manner the rapid positioning of the mold 10 with reference to the hopper is greatly facilitated.

When the hopper is elevated from the mold the die pallet or "top hat" 20 is prevented from sticking to the underside of the casting member 59 by means of resiliently mounted kick-off lugs 75 which are slidable in recesses 76 in the casting member 59. The lugs 75 are urged outwardly by expansible springs 77 interposed between the lugs 75 and the bushing part 78. To prevent the lugs 75 from coming out of recesses 76, they are secured to pins 79 slidable in bushing parts 78, the pins 79 having heads 80 which act as stops to prevent the pins from passing through bushing part 78. The heads 80 are movable in recesses 81 which are covered at the top by caps 82 to keep concrete in the hopper from clogging their movement. The kick-off lugs 75 tend to push the die pallet away from the casting member 59 when the hopper is elevated from the mold 10 and prevents the die pallet from being disturbed in any way.

In the modifications shown in Figs. 1, 3, 4, 5 and 6, the die pallet 22 has a ring or collar 23 which fits inside the opening 35 in the die pallet. This ring comes flush with the inside surface of the die pallet 22 so as to form the surface of at least a portion of the end of the male end of the duct. The ring preferably has somewhat greater thickness than the wall of the top portion of the die pallet and preferably has an annular portion 83 overlying the top end of the die pallet. The bottom of the casting member 59 preferably rests on die pallet 20 so that the pallet, as interposed between the hopper and the upper end of the mold, can be pressed firmly down by the hopper and maintained firmly on the top of the mold 10. The bottom of the casting member 59 can be appropriately grooved as shown to accommodate the portion of ring 28 which projects above the upper surface of the die pallet. The collar or ring 28 is in slidable relation with reference to the opening 35 in the die pallet and is preferably maintained in position with reference to the die pallet by means of pins 37 which can be removably inserted in registered holes in the wall of die pallet 22 and in the ring 28 so as to leave a slight clearance between the upper surface of the die pallet and the under side of the annular portion 83 of the collar 28. The collar 28 is preferably made of some wear-resistant material.

Alternatively as shown in Figs. 7 and 8, a collar or ring 39 may be fixedly held in the casting member 59 as by setting the collar in annular groove 94. The collar can be maintained in place by lock arms 95 which are swingable about pins 96 so that the ends thereof can be swung into and away from position overlying the collar 39 to lock the collar in place. In this modification the die pallet 22 has the upper curved end portion 97 in the form shown in Fig. 7 and the collar 39 serves to form at least a portion of the end surface of the male end of the duct. Otherwise the structure shown in Figs. 7 and 8 is the same as that shown in Figs. 1, 2, 3 and 4.

The rotatable shaft 31 has a former head 32 attached to the end thereof and suitable means (not shown) are provided for elevating and lowering the shaft 31 during rotation thereof. The apparatus permits the former head to be lowered to the bottom of the mold, e. g., to the position shown in dotted lines in Fig. 1 and thereafter to be elevated up to the top of the mold and up through the collar 28 (or 39) in the hopper while it is being rotated. The diameter of the former head 32 should be approximately the same as the internal diameter of the collar 28 (or ring 39) and of the desired internal diameter of the duct to be formed within the mold. Immediately above the former head 32 are one or more trowel-

ing compactors 98 which are fixed to the shaft and serve to compact moldable material, e. g., moist concrete, against the walls of mold 10 and to trowel the interior surface of the duct to as smooth a condition as possible. While a conventional form of former head and troweling compactor is shown in the drawings, of which many types are known, it is regarded as preferable, particularly when an externally square duct is to be molded, to employ the novel core former device shown and described in my application Ser. No. 93,785, filed August 1, 1936, for Core former for making ducts (executed on even date herewith).

The shaft 31 may be guided as by a bushing in bracket 92 which also guides the rods 91 that maintain the hopper 27 in position. With this construction, it is apparent that when the mold 10 is brought into proper alignment with the hopper 27, the mold is also brought into proper alignment with the shaft 31 and the core former carried thereby.

While the manner of use of the apparatus above described is regarded as apparent, certain steps in the use thereof will be described for the purpose of illustration. The portions 12 and 15 of the mold are placed in complementary relation to each other and are clamped together in this relation by the clamping members. The assembled mold is then placed on the support 11 and is maintained in proper position thereon by blocks 52 and lugs 53. The die pallet 20 is next placed on top of the mold and is maintained in proper alignment therewith by the pins 26. Thereafter the mold is brought under the hopper 27 and the hopper 27 is lowered and proper alignment with the mold is assured both by blocks 62 together with pin 64 and by pins 26. The mold is thus firmly held between the lower portion of the hopper and the support 11. Moreover the die pallet 20 is securely held between the top of the mold and the bottom of the hopper. The die 19 is raised through the opening in the foundation member 11 and the forming head 32 is lowered to position adjacent the bottom of the mold. If desired, the forming die 19 can have a cylindrical core 33 to accommodate the forming head 32 so as to permit the forming head to be lowered to the bottom of the mold. Moldable material 34 such as moist concrete 34 is next poured from the hopper 27 into the mold in an amount which is somewhat in excess of that which is necessary for the formation of the finished duct. The forming head is then rotated and is gradually elevated while being rotated. The concrete is compacted against the side wall of the mold by the troweling compactor and is smoothed by the troweling compactor and by the forming head. After the forming head has been elevated out of the top of the mold and up through the opening in the bottom of the hopper 27, the duct will have been formed within the mold. By then elevating the hopper 27 above the mold and lowering the die 19, the mold with the formed duct therein can then be moved to one side on the movable support 11 with the die pallet remaining undisturbed thereon.

The die pallet 20 can now be removed from the upper end of the mold. The pins 26 furnish guides so that the movement of the pallet is limited throughout a substantial distance adjacent the top of the mold to movement in the direction of the axis of the mold. The die pallet can be pulled upwardly by having a workman place his fingers underneath the ears 24 and urging the pallet upwardly. It is preferable, however, especially when the concrete is very tender to remove the pins 37 which maintain the collar 28 in assembled relation with the die pallet so that the collar 28 will be free to slide within the opening in the top of the die pallet. Due to the slight clearance between the annular part 83 of the collar 28 and the top of the die pallet, the collar 28 can be lightly urged downwardly on the surface of the end of the male portion of the duct to keep the concrete in the male portion of the duct compacted while the die pallet is being loosened. As soon as the die pallet becomes loosened from the concrete, the collar 28 becomes carried by the die pallet, as shown in Fig. 6, and becomes readily removable with the die pallet. This obviates all danger of having the moist concrete in the male end of the duct cling to the pallet or be damaged in any way.

When the modification shown in Fig. 7 is used, the collar or ring 39 remains fixed to the hopper when the hopper is removed from the upper end of the mold. In such case a separate ring or collar of the general shape of collar 88, for example, can be placed on the exposed end of the male portion of the duct and employed in the manner described above in compacting the concrete while the die pallet is being removed from the upper end of the mold. In such case, however, the ring 88 preferably has the portion thereof slidable within die pallet 20 quite short as shown in Fig. 10 so that the ring becomes carried by the die pallet immediately after it has been used to loosen the concrete in the die pallet.

After the die pallet has been removed, the mold clamps can be moved from clamping position so that the two halves of the mold can be separated and the molded duct removed therefrom.

Apparatus embodying this invention has enabled me to successfully mold concrete ducts with very low percentage of units rejectable because of defects in the male end of the ducts. Prior to the development of this invention, many different types of apparatus were used for introducing concrete into the mold and for maintaining a die adapted to form the outside surface of the male end of the duct. However, due to several types of accidents the male ends of the ducts were broken, cracked, or deformed or clung to male die so that the percentage of rejects was much greater than successful commercial operation would permit. This was particularly true in the making of ducts wherein the walls of the male portion are not only thin but also are relatively long so as to permit a very substantial overlap in bringing together the male and female ends of adjoining ducts. The defects in earlier apparatus have been substantially eliminated in commercial utilization of this invention and the improvements described herein are of great value in the manufacture of ducts.

While certain specific embodiments of this invention have been shown and described herein, it is to be understood that this has been done merely for the purpose of illustration and that apparatus embodying this invention may take various forms. Accordingly the scope of this invention is to be limited only by the language of the following claims.

I claim:

1. In apparatus of the character described, the combination comprising a vertically extending mold adapted to form the external surface of a molded duct, a hopper having an opening in the bottom thereof adapted when positioned over the upper end of said mold to discharge moldable material into said upper end of said mold, means for maintaining said hopper in position over said end of said mold and for causing said hopper to become elevated vertically above and spaced substantially away from said end of said mold and to become returned to position at said end of said mold, a die pallet which is adapted to form the external surface of a male end of said duct having an opening therein adapted to register with said opening in said hopper and which is interposed between said end of said mold and the bottom of said hopper, and means presented by said hopper adapted to coact with said die pallet to maintain said opening in said hopper in aligned registration with said opening in said die pallet and to prevent said die pallet from being moved away from said end of said mold when said hopper is in position at said end of said mold, said hopper being adapted to be removed from position at said end of said mold while said pallet remains at said end of said mold.

2. In apparatus of the character described, the combination comprising a vertical mold adapted to form the external surface of a molded duct, a hopper having an opening therein adapted to discharge moldable material through said opening into the upper end of said mold, vertically extending pins upstanding from said end of mold, recesses in members fixed to said hopper adapted to coact with said pins to maintain said hopper and said upper end of said mold in alignment, means for moving said hopper into and away from position at said end of said mold, a die pallet adapted to form the external surface of a male end of said mold and interposed between end of said mold and said hopper, ear members integral with said pallet and having holes in which said pins are slidable, said hopper being adapted for removal from said end of said mold while said pallet remains in place over said end of said mold with said pins inserted in said holes in said ear members.

3. In apparatus of the character described, the combination comprising a mold adapted to form the external surface of a molded duct, a hopper having an opening therein adapted to discharge moldable material into an end of said mold when said hopper is at said end of said mold, means for moving said hopper into and away from position at said end of said mold, a die pallet adapted to form the external surface of a male end of said duct, said pallet having an opening in the end of a tapered portion thereof adapted to register with said opening in said hopper and being interposed between said hopper and said end of said mold, and a collar which is adapted to form the external surface of at least a portion of the end surface of the male end of said duct and which is in separable relation with respect to said die pallet, said hopper being adapted to be removed from the end of said mold while said die pallet remains in place at the end of said mold.

4. In apparatus of the character described, the combination comprising a mold adapted to form the external surface of a molded duct, a hopper having an opening therein adapted to discharge moldable material into an end of said mold when said hopper is at said end of said mold, means for moving said hopper into and away from position at said end of said mold, a die pallet adapted to form the external surface of a male end of said duct, said pallet having an opening in the end of a tapered portion thereof adapted to register with said opening in said hopper and being interposed between said hopper and said end of said mold, a collar which is adapted to form the external surface of at least a portion of the end surface of the male end of said duct and which is in separable relation with respect to said die pallet, and means for maintaining said die pallet and said mold in alignment when said hopper is moved away from position at said end of said mold, said hopper being adapted to be removed from the end of said mold while said die pallet remains in place at the end of said mold.

5. In apparatus of the character described, the combination comprising a mold adapted to form the external surface of a molded duct, die pallet adapted to form the external surface of a male end of said duct which pallet has an opening therethrough and is adapted to be moved away from the end of said mold longitudinally of the axis of said mold, and a ring fitting slidably within said opening in said pallet.

6. In apparatus of the character described, the combination comprising a mold adapted to form the external surface of a molded duct, die pallet adapted to form the external surface of a male end of said duct which pallet has an opening therethrough and is adapted to be moved away from the end of said mold longitudinally of the axis of said mold, and a ring fitting slidably within said opening in said pallet, said ring including a portion having greater diameter than the diameter of said opening in said pallet which limits the extent to which said ring may be slid through said opening in said pallet toward the interior of said mold.

7. In apparatus of the character described, the combination comprising a vertical mold adapted to form the outer surface of a molded duct, a die pallet adapted to form the outer surface of the male end of said duct, and means which is on the outside of said mold and which is coactive between said pallet and by said mold adapted to limit movement of said pallet throughout a substantial distance adjacent said end of said mold to movement in the direction of the axis of said mold.

8. In apparatus of the character described, the combination comprising a vertical mold adapted to form the outer surface of a molded duct, a die pallet resting on the upper end of the walls of said mold which is adapted to form the outer surface of a male end of said duct, and pins upstanding from the upper end of said walls of said mold, said die pallet having holes therein slidable over said pins for maintaining said die pallet and mold in axial alignment.

9. In apparatus of the character described, the combination comprising a vertical mold adapted to form the outer surface of a molded duct, a former head adapted to form the inside surface of said duct, means for rotating and for lowering and raising said former head within said mold, a die pallet for forming the outer surface of the male end of said duct which is adapted to rest on the upper end of said mold and which includes a tapered portion extending upwardly from the upper end of said mold and is provided with an opening through which said former head can pass, means coactive between said mold and said

die pallet to maintain said mold and die pallet in axial alignment, a hopper having an opening therein adapted to register with said opening in said die pallet and through which said former head can pass, means for maintaining said hopper over the upper end of said mold with the opening therein in registry with said opening in said die pallet, means presented by said hopper adapted to maintain said die pallet firmly against the upper end of said mold and between said mold and said hopper with the opening in said pallet in juxtaposition with the opening in said hopper when said hopper is in position at said end of said mold, means for maintaining said hopper and said mold in alignment when said hopper is in position at said end of said mold, and means for moving said hopper away from said end of said mold leaving said die pallet remaining in place at said end of said mold.

10. In apparatus of the character described, the combination comprising a mold adapted to form the outer surface of a molded duct, a hopper adapted, when positioned at an end of said mold, to discharge through an opening therein moldable material into said end of said mold, means for moving said hopper toward and away from said end of said mold, a die pallet adapted to form the outer surface of the male end of said duct interposed between said end of said mold and said hopper and having an opening therein adapted to register with the opening in said hopper, and members resiliently mounted on said hopper for pressure contact against said die pallet when said hopper is in position at said end of said mold and adapted for pushing said die pallet away from said hopper when said hopper is moved away from said end of said mold.

11. In apparatus of the character described, the combination comprising a mold member adapted to form the outer surface of a molded duct, a hopper member adapted, when positioned at an end of said duct to discharge moldable material through an opening therein into said end of said mold, means for moving said hopper toward and away from said end of said mold, and means interposed between said hopper and said mold for aligning said hopper with said mold including a pin protruding from one of said members and a part secured to the other of said members adapted to be maintained in alignment with said pin upon pressure contact between said pin and said part, said pin being resiliently mounted for maintaining pressure contact with said part throughout a substantial range of movement of said hopper in being moved toward said mold.

12. In apparatus of the character described, the combination comprising a vertical mold adapted to form the outer surface of a molded duct, a hopper adapted, when positioned at the upper end of said mold, to discharge moldable material through an opening therein into said end of said mold, means for elevating and lowering said hopper away from and toward said end of said mold, and means for aligning the upper end of said mold with said hopper including stop block means secured to said hopper adapted to contact with the outer surface of a side wall of said mold at said upper end thereof, a downwardly projecting pin presenting a tapered end resiliently mounted on said hopper on a substantially opposite side of said upper end of said mold and a part carried by said mold adapted to receive said tapered end of said pin and to maintain said part in alignment with said pin when said tapered end is in pressure contact therewith.

13. In apparatus of the character described, the combination comprising a mold adapted to form the outer surface of a molded duct, a former head adapted to form the inside surface of said duct, means for rotating and for moving said former head longitudinally within said mold to form the inside surface of said duct, a hopper having an opening therein through which said former head can pass and adapted when in position at an end of said mold to discharge through said opening moldable material into said end of said mold, means for moving said hopper into and away from said position at said end of said mold, a die pallet which is adapted to form the outer surface of a male end of said duct and which is interposed between said end of said mold and said hopper and which has an opening therein through which said former head can pass, and means for maintaining said hopper, said die pallet, and said mold firmly in position with said die pallet between said hopper and mold at said end of said mold and with said opening in said die pallet and said opening in said hopper in alignment with the longitudinal axis of said former head when said hopper is in position at said end of said mold, said die pallet being adapted to remain in place at said end of said mold when said hopper is moved away from said end of said mold and being readily removable from said end of said mold when said hopper is spaced from said end of said mold.

14. In apparatus of the character described, the combination comprising a mold adapted to form the outer surface of a molded duct, a former head adapted to form the inside surface of said duct, means for rotating and for moving said former head longitudinally within said mold to form the inside surface of said duct, a hopper having an opening therein through which said former head can pass and adapted, when in position at an end of said mold, to discharge through said opening therein moldable material into said end of said mold, a die pallet which is adapted to form the outer surface of a male end of said duct and which is interposed between said end of said mold and said hopper and which has an opening therein through which said former head can pass, means for maintaining said hopper and said die pallet in position at said end of said mold so that said former head can be removed from said mold through said opening in said die pallet and through said opening in said hopper, and means for moving said hopper into and away from said position at said end of said mold, said die pallet being adapted to remain in place at said end of said mold when said hopper is moved away from said end of said mold and being readily removable from said end of said mold when said hopper is spaced from said end of said mold.

15. Apparatus according to claim 14 in which, when said hopper is spaced from position at the end of the mold, the die pallet is separable from a molded duct formed in said mold by non-rotary movement longitudinally with respect to said mold, means being provided which coact between said mold and said die pallet so that in separating said die pallet from said mold the movement of the die pallet is limited to movement longitudinally of said mold.

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