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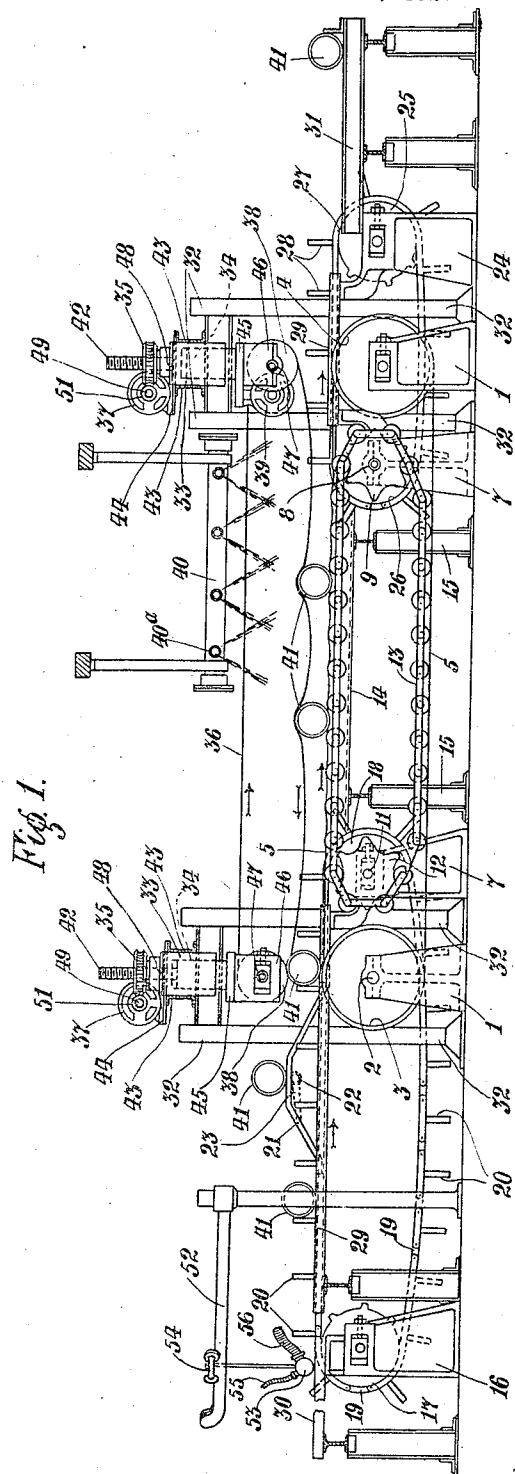
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1,737,446

LINING OF IRON AND STEEL PIPES, TUBES, AND OTHER HOLLOW BODIES

Filed June 27, 1927

4 Sheets-Sheet 1



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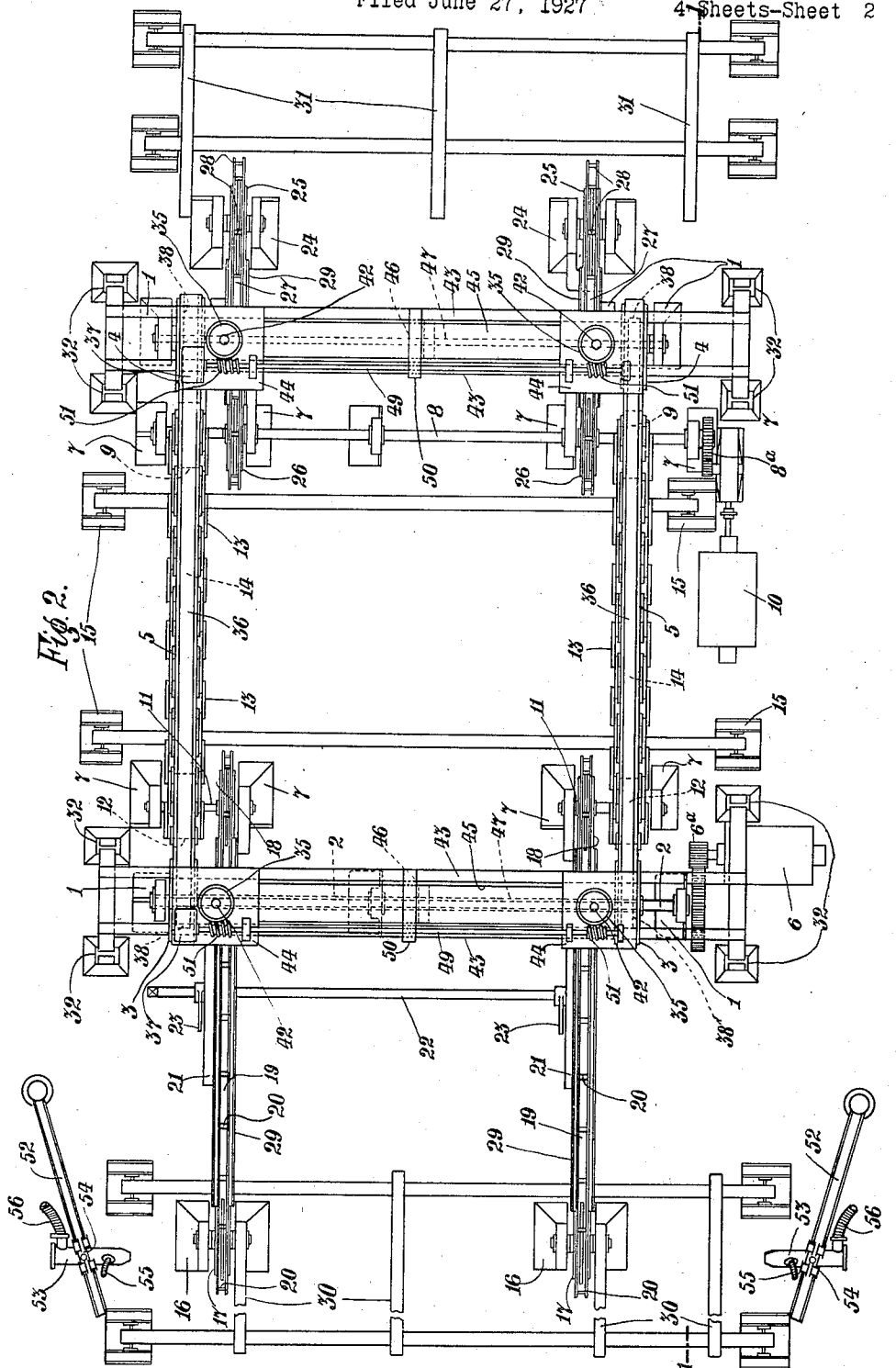
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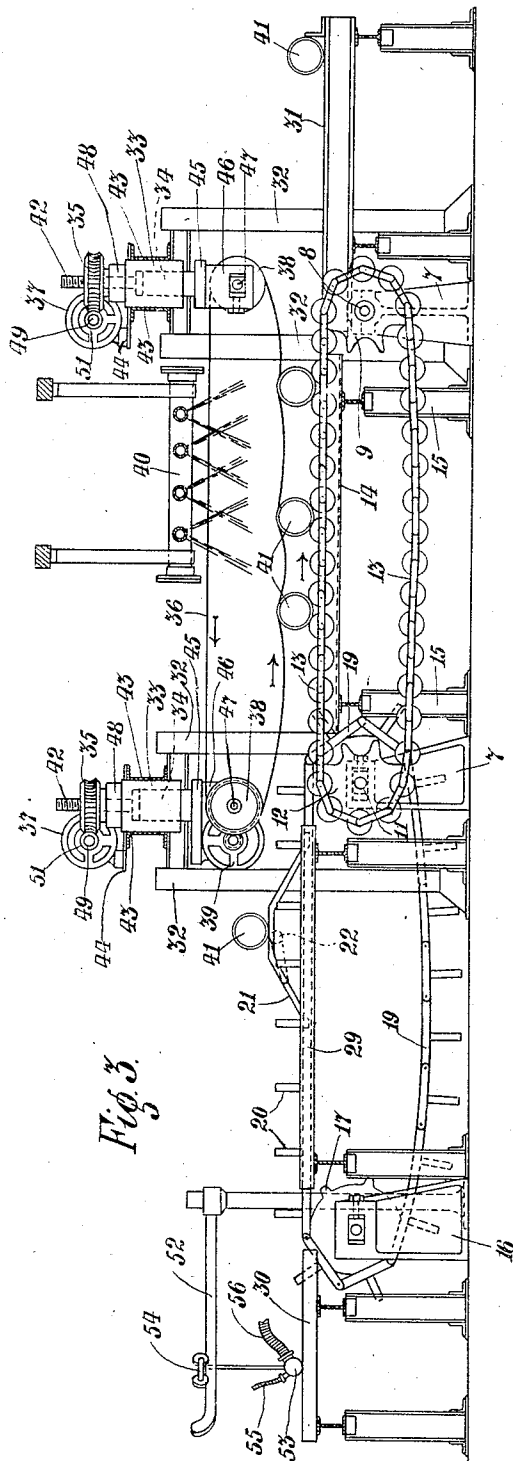
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4 Sheets-Sheet 3



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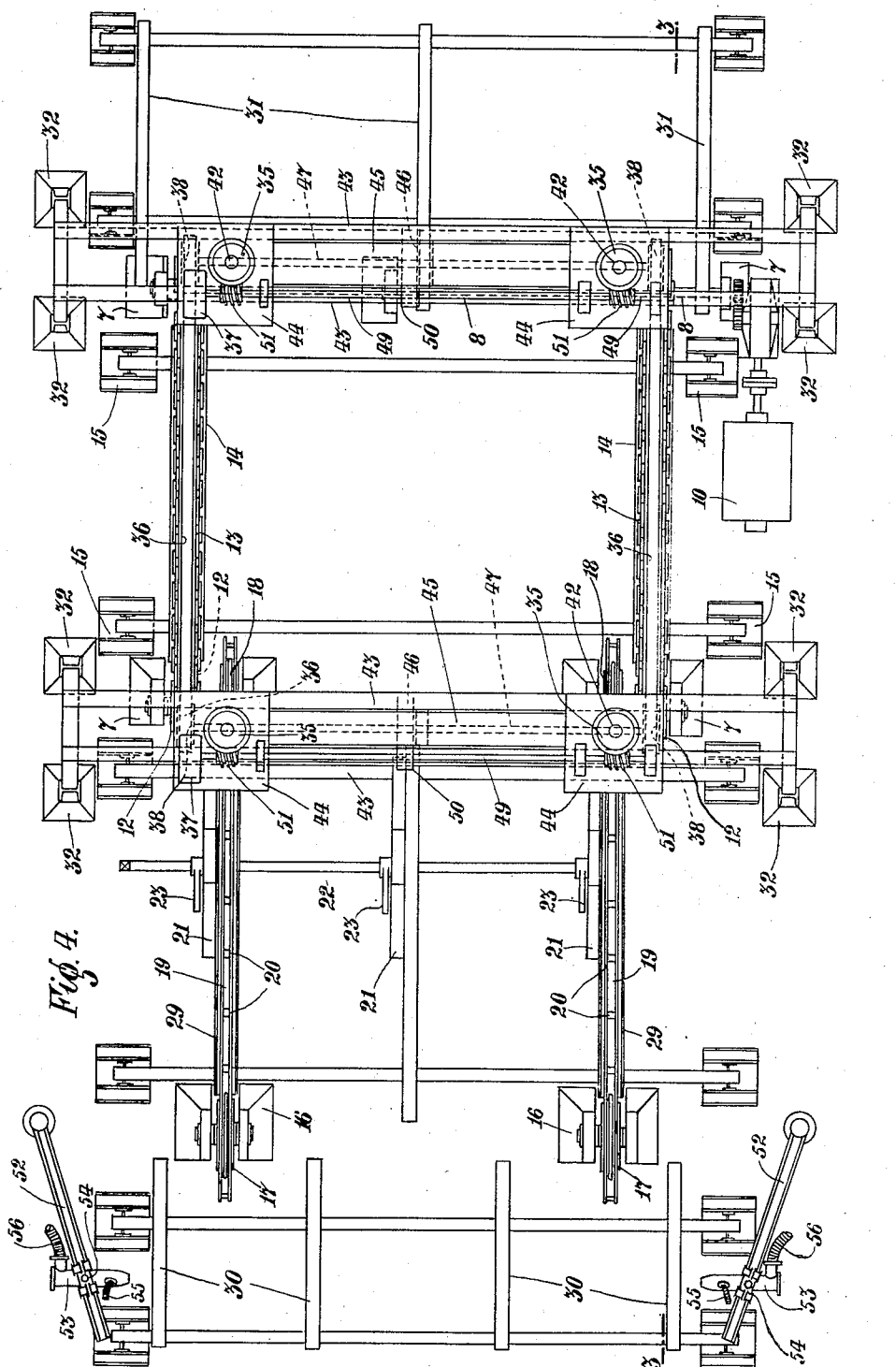
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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LINING OF IRON AND STEEL PIPES, TUBES, AND OTHER HOLLOW BODIES

Application filed June 27, 1927, Serial No. 201,930, and in Great Britain January 1, 1927.

This invention relates to the centrifugal lining of iron and steel pipes, tubes and other hollow bodies with a bituminous substance such as natural or artificial asphalt, or other bituminous material or composition (hereinafter referred to as "substance") by spinning the pipes or the like, when charged with the bituminous substance in liquid form so that the substance will be uniformly distributed, by centrifugal action, over the interiors of the pipes or the like.

The object of this invention is to provide improved apparatus for centrifugally lining the iron and steel pipes, tubes and other hollow bodies (hereinafter referred to, throughout the specification, simply as "pipes") whereby large numbers of pipes can be treated in rapid succession, and the treatment be carried on continuously.

According to this invention, the improved apparatus comprises upper and lower travelling members between which the pipes, after having been charged with the bituminous substance in liquid condition, are fed one after the other, the travelling members acting on the pipes and, while translating them, also spinning them rapidly about their own axes so as to distribute the lining substance uniformly over the interior surfaces thereof. The spinning of the pipes about their own axes may be effected either by causing the upper travelling members and the lower travelling members to move in opposite directions or by causing them to move in the same direction but at differential speeds which effects the same action.

The apparatus preferably comprises a plurality of endless, parallel, power driven roller chains and, thereabove, a plurality of endless, parallel power driven belts whose lower stretches move with a linear velocity different from that of the upper stretches of the roller chains so that when the pipes, after having been charged with the bituminous substance in a liquid condition, are fed on to the chains whereon they lie transversely between adjacent rollers, they are translated bodily, while the belts contacting with them cause them to spin simultaneously about their

own axes to distribute the liquid lining substance.

A plurality of lower endless power driven belts may be provided, each arranged around one of the roller chains so that its upper stretch is slack and rests upon the upper stretch of the roller chain which moves under the belt in the same direction but relatively slowly so that, when charged pipes are fed in between the upper and lower belts, the latter sag thereunder between the rollers of the chains forming hollows by the progression of which the pipes are translated bodily while at the same time being acted on by the differentially moving adjacent stretches of the upper and lower belts and are thereby spun.

In order that the invention may be clearly understood two embodiments thereof will be described by way of example and with reference to the annexed drawings, whereon:—

Fig. 1 is a side elevation of apparatus for lining pipes made in accordance with this invention, and illustrated in section on the line 1—1 of Fig. 2,

Fig. 2 is a plan view of the apparatus with the water spray apparatus not shown,

Fig. 3 is a side elevation of a modified form of apparatus, in section on the line 3—3 of Fig. 4, and

Fig. 4 is a plan view corresponding to Fig. 3.

On the drawings, Figs. 1 and 2, the numerals 1 denote uprights on strong foundations, between two of which is a shaft 2 carrying belt pulleys 3 spaced apart. The remaining uprights 1 carry two belt pulleys 4 each corresponding to a pulley 3. Endless belts 5 are passed round the pairs of corresponding pulleys 3 and 4.

The shaft 2 is geared by gearing 6^a to an electric motor 6.

A number of uprights 7 are arranged as shown in the drawing. The uprights 7 at the right hand as seen in the drawing carry a shaft 8 which carries two spaced sprocket wheels 9 and is geared through reduction gearing 8^a to an electric motor 10. The remaining uprights 7 carry two short co-linear

shafts 11 each bearing a sprocket wheel 12. The shaft 8 passes between the upper and lower stretches of the belts 5 near the pulleys 4, and the two shafts 11 pass between the said upper and lower stretches near the pulleys 3.

Over each of the sprocket wheels 9 and its corresponding sprocket wheel 12 a broad endless roller chain 13 is passed, there being thus two such chains. Each chain 13 is arranged in the plane of one of the belts 5 between the upper and lower stretches thereof and between the supporting pulleys 3 and 4 thereof, as shown, the arrangement being such that the upper stretch of the belt 5 rests on the upper stretch of the corresponding chain 13, which is supported by, and adapted to run upon, a stationary bar or skid 14 mounted on supports 15.

At the left hand end of the apparatus are two further uprights 16 each carrying a sprocket wheel 17. The short shafts 11 carry two sprocket wheels 18 corresponding to the sprocket wheels 17 and around each pair of corresponding sprocket wheels 17 and 18 an endless chain or band 19, having projecting pins or stoppers 20 on it, is passed. These two bands 19 together form a feed conveyor.

Alongside each of the bands 19 is placed a stationary ramp 21 comprising an incline, a horizontal part and a decline. A transverse spindle 22 is supported in bearings below the ramps and has two arms 23 fast on it. The shaft 22 has a square end (see Fig. 2) and can be turned by a crank handle.

At the right hand end of the apparatus are two more uprights 24 supporting sprocket wheels 25 which correspond to two sprocket wheels 26 fixed on the shaft 8. The sprocket wheels 25 and 26 carry between them two endless chains or bands 27 having projecting pins or stoppers 28. These bands 27 form together a discharge conveyor.

The upper stretch of each of the bands of the feed conveyor and of each of the bands of the discharge conveyor is supported by a stationary bar or skid 29, there being four stationary bars as shown.

30 denotes a series of longitudinal parallel bars of the same height as the feed conveyor and forming a feed rack.

31 denotes a series of longitudinal parallel bars forming a discharge rack, slightly lower than the discharge conveyor.

In line with the extremities of the belts 5 are two transverse gantries bridging the said belts. These gantries each comprise uprights 32 and transverse beams 43 supported by the uprights. Approximately above the belts 5 each gantry has two platforms 44 mounted on it and below each platform there is a guide member 33 in which blocks 34 are vertically slidable. The blocks 34 carry between them and below them a movable transverse beam 45 having hangers 46 in which a transverse shaft 47 is journaled. The shaft

47 is provided above each of the belts 5 with a belt pulley 38. An electric motor 39 is hung under the movable beam 45 of the right hand gantry and is geared to the shaft 47 of that gantry.

Each of the four blocks 34 has an upright rod 42 fixed to it, the rod being screw-threaded and passing upwards through its platform 44. A worm wheel 35 is screwed on the rod 42 and rests on a bearing surface 48 on the platform. The weight of the movable beams 45 is thus transmitted through the rods 42 and worm wheels 35 and borne by the bearing surfaces 48. A transverse shaft 49 is supported above and between each pair of corresponding platforms 44, an intermediate bearing 50 being provided on one of the beams 43. Each of the shafts 49 has a worm 51 near each end to engage with the worm wheels 35 and each shaft is driven by a motor 37 mounted on one of the platforms.

The two belts 36 extend between the belt pulleys 38 above the belts 5, means being provided for adjusting the tension of the belts, such means being also provided in connection with the other belts and chains.

The electric motor 37 are arranged to operate simultaneously. Consequently, when the motors are working, the worm wheels 35, which fit as nuts on the rods 42, will be rotated in unison and, by their screw action, will raise or lower the movable beams 45 with the belts 36 simultaneously, the blocks 34 being slid in the guide members 33. Hence the distance between the upper stretches of the lower belts 5 and the lower stretches of the upper belts 36 can be adjusted in order to suit pipes of different diameters.

The lower stretches of the belts 36 are arranged to be slack.

Water spraying apparatus 40 is supported above the pipes as shown so as to spray water on them for cooling purposes. The water spraying apparatus comprises a series of perforated pipes 40^a which extend across the apparatus so that the water may act upon the pipes throughout their lengths.

52, 52 are two swinging jibs each carrying an oil gas burner or burners 53 of known type for heating pipes. Each burner is carried by a trolley 54 movable along the jib so that a wide range of adjustment of the burners is possible. 55 and 56 represent hose for conveying the oil and air respectively to the burners. The burners 52 are adapted to project long flames into the interior of the pipes on the feed rack, or, if desired, on the conveyor bands 19.

The following is the operation of lining pipes by means of the apparatus described.

The distance between the upper belts and the lower belts 5 is adjusted as before described to suit the diameter of the pipes to be lined. The electric motor 6 is then started and drives the shaft 2, the pulleys 3 and the

lower belts 5 in the direction indicated by the arrow. The motor 39 is started to drive the belts 36 in the direction indicated by the arrows and at the same linear velocity as the lower belts 5, so that the upper stretches of the lower belts and the lower stretches of the upper belts are moving in opposite directions at the same speeds.

The motor 10 is started and drives the shaft 8, the sprocket wheels 9 and the roller chains 13 on whose upper stretches the belts 5 run. The chains 13 move in the same sense as the lower belts 5 but at a very low linear speed in comparison with the speed of said belts, so that there is relative motion between the contacting upper stretches of the belts 5 and of the chains.

Rotation of the sprocket wheels 12 of the roller chains causes rotation of the shafts 11 and of the sprocket wheels 18 whence the feed conveyor bands 19 are driven at the same velocity as the chains 13. Similarly the discharge conveyor bands 27 are driven from the shaft 8 through the medium of the sprocket wheels 26.

When the various bands are in motion as above described, the pipes to be lined, marked 41 throughout, are placed transversely on the feed rack 30 where their ends are plugged by rings and a number of detachable collars or rings are clamped around them to act as guide-flanges while on the apparatus. Thereafter they are rolled in succession along the rack and are caught by the stoppers 20 of the feed conveyor bands 19. Hereafter, for clearness in description, the treatment of one pipe will be described, but it will be understood that the pipes follow one another along the apparatus in quick succession. While on the feed conveyor bands the pipe is heated, for instance by the application of an oil or gas flame or flames and is then carried on to the ramps 21 and raised off the bands 19. When a certain distance up the ramps the pipe comes over the arms 23 on the spindle 22. The spindle is rotated either manually or mechanically and the arms carry the pipe on to the horizontal parts of the ramps where it is charged with hot bituminous substance in liquid condition. For this purpose, the bituminous substance may be supplied in a heated and liquid condition from a reservoir, tank or the like by means of one or more counterweighted ladles, each ladle containing a measured quantity of the substance which is tipped into the pipe from one or both ends. A period of rest for each pipe may be arranged for during charging but as a rule is unnecessary as the pipe is moving very slowly.

The pipe, after charging, moves off the ramps into engagement with the stoppers of the feed conveyor whereby it is carried in between the upper and lower belts 36 and 5 and the pipe is deposited on the lower belts which are contacting with the roller chains 13.

The mere contact of the pipe with the upper and lower belts would only spin the pipe without translating it, but with the arrangement described, each pipe assumes a position between a pair of adjacent rollers of the chains, the belts 5 sagging below the pipe and accommodating themselves to the curvature thereof. The result is that while being spun rapidly by the belts to distribute the lining substance centrifugally and also while being cooled, the pipe is being carried along by the progression of the hollow in which it rests, at the same speed as the chains.

Spinning and translation is continued until the lining substance has been uniformly distributed over the interior wall of the pipe and while the pipe passes below the water spraying means 40 where it is cooled, spinning in all cases continuing until the lining is hard enough to support itself.

On reaching the end of the roller chains 13 the pipe is caught by the stoppers 28 of the discharge conveyor bands and carried out from between the belts on to the discharge rack 31.

The pipes follow one another in quick succession through the apparatus as long as pipes are fed in, the process being continuous and no handling required.

As before mentioned, the drive of the upper belts 36 is arranged so that the lower stretches thereof are slack, giving a greater lap of the belts on the pipes.

Instead of heating the pipes while on the feed conveyor they may be heated in a furnace and then introduced into the spinning apparatus.

The temperature of the pipes when being charged with hot bituminous substance should be somewhat greater than the temperature of the lining substance.

In the modified form of lining apparatus shown in Figs. 3 and 4, the lower belts 5 are dispensed with, the pipes resting directly on the rollers of the roller chains 13 by which they are carried along, the hollows between the rollers forming cradles for the pipes in which they are spun by the action of the upper belts 36 which travel at a greater linear speed than the chains 13 and their lower stretches move in the same direction as the upper stretches of the chains. In this modification, in the drawings of which the same reference numerals as used for the first form of the invention, Figs. 1 and 2, are used, the discharge conveyor has been also dispensed with.

It will be appreciated that pipe lining apparatus according to this invention is susceptible of numerous variations. There may be any practicable number of upper belts and lower belts and chains. For treating pipes of varying diameters, the stoppers on the various conveyors may be adjustably secured on the endless bands. Instead of a number of

ramps 21 being provided, one only, located at one side of the feed conveyor, may be used so that the pipes on being carried on to the ramp, are tilted to facilitate charging.

5 After the application of the cooling water from the spraying means, the pipes may be subjected to the action of rotary or other brushes in order to clean and dry their exterior surfaces.

10 Preferably the belts, roller chains and feed and discharge conveyors are arranged to be slightly inclined, the feed end being higher than the discharge end.

I claim:—

- 15 1. Apparatus for centrifugally lining iron and steel pipes with a liquid bituminous substance, comprising continuously running lower travelling members, upper travelling members moving continuously with a linear velocity different from that of the lower travelling members, and means for feeding said pipes after they have been charged with liquid bituminous substance in between the upper and lower travelling members where they are translated by the lower members and spun simultaneously about their own axes by the co-action of the upper and lower members to distribute the bituminous substance as a lining uniformly over their interior surfaces.
- 20 2. Apparatus for centrifugally lining iron and steel pipes with a liquid bituminous substance, comprising a plurality of continuously running endless, power driven roller chains moving parallel to each other in the same sense, a plurality of continuously running endless, power driven belts moving parallel to each other in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of said chains, and means for feeding the pipes after they have been charged with liquid bituminous substance on to the chains and in between the chains and the belts so that the chains translate the pipes and the co-action of the chains and belts spin the pipes about their own axes to distribute the bituminous substance as a lining.
3. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance comprising a plurality of continuously running endless, power driven roller chains moving parallel to each other and in the same sense, a plurality of continuously running endless, power driven belts moving parallel to each other in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of said chains, means for feeding the pipes after they have been charged with bituminous substance on to the chains transverse to which they lie and in between the chains and belts for simultaneous translation and spinning to distribute the bituminous substance, and means for moving the belts bodily towards

and away from the chains to accommodate pipes of different diameters.

4. Apparatus for centrifugally lining iron and steel pipes with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of continuously running endless, power driven roller chains moving parallel to each other and in the same sense, a plurality of continuously running endless power driven belts moving parallel to each other in the same sense and so that their lower stretches move above the chains with a different linear velocity from the upper stretches of the chains, means for feeding the pipes after they have been charged with the liquid bituminous substance on to the chains and in between the chains and belts for simultaneous translation and spinning to distribute the bituminous substance, means for cooling the pipes while still being spun, and mechanism for moving the belts bodily towards and away from the chains to accommodate pipes of different diameters.

5. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of endless, power driven roller chains moving parallel to each other in the same sense, a plurality of endless, power driven belts moving parallel to each other in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a number of parallel endless bands forming a conveyor for feeding the pipes on to the chains and in between the chains and the belts where they are translated bodily and simultaneously spun about their own axes to distribute the bituminous substance, and stationary ramps on to and over which the pipes are carried when being charged with the liquid bituminous substance.

6. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of endless, power driven roller chains moving parallel to each other in the same sense, a plurality of endless, power driven belts moving parallel to each other in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a number of parallel endless bands forming a conveyor for feeding the pipes on to the chains and in between the chains and the belts where they are translated bodily and simultaneously spun about their own axes to distribute the bituminous substance, stationary ramps on to and over which the pipes are carried when being charged with the liquid bituminous substance and mechanism for moving the belts bodily towards and away from the chains to accommodate pipes of different diameters.

7. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of endless, power driven roller chains moving parallel to each other in the same sense, a plurality of endless, power driven belts moving parallel to each other in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a number of parallel endless bands forming a conveyor for feeding the pipes on to the chains and in between the chains and the belts where they are translated bodily and simultaneously spun about their own axes to distribute the bituminous substance, stationary ramps on to and over which the pipes are carried when being charged with the liquid bituminous substance, mechanism for moving the belts bodily towards and away from the chains to accommodate pipes of different diameters, and means for cooling the pipes while still being spun.

10. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of parallel endless, power driven roller chains moving in the same sense, a plurality of parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a number of parallel endless bands forming a conveyor for feeding the pipes on to the chains and in between the chains and belts for simultaneous translation bodily and spinning about their own axes, stationary ramps on to and over which the pipes are carried when being charged, supports for said belts, housings in which said supports are slidable so that the supports can be moved together to move the belts and to vary the distance between the belts and the chains, and means for cooling the pipes while still being spun.

8. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of continuously running endless, power driven roller chains moving parallel to each other in the same sense, a plurality of continuously running endless, power driven belts moving parallel to each other in the same sense and so that their lower stretches move over the chains with a different linear velocity from that of the upper stretches of the chains, means for feeding the pipes, charged with the bituminous substance in liquid condition, on to the chains and in between the chains and the belts where they are translated bodily and simultaneously spun to distribute the bituminous substance, supports for said belts, housings in which said supports are slidable so that the supports can be moved together to move the belts and to vary the distance between the belts and the chains, and means for cooling the pipes while still being spun.

9. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of continuously running parallel endless, power driven roller chains moving in the same sense, a plurality of continuously running parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a number of parallel endless bands forming a conveyor for feeding the pipes after they have been charged with liquid bituminous substance on to the chains and in between the chains and belts for simultaneous translation bodily and spinning about their own axes, stationary charging ramps on to and over which the pipes are carried before spinning, supports for said belts, housings in which said supports are slidable so that the supports can be moved together to move the belts and to vary the distance between the belts and the chains, and means for spraying water upon the pipes after distribution of the bituminous substance by spinning and while the pipes are still spinning.

12. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of parallel endless, power driven roller chains moving in the same sense, a plurality of parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper

stretches of the chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, and means for feeding the
 5 pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, the pipes being translated bodily by the progression of said hollows wherein they are simultaneously spun about
 10 their own axes by the co-action of the differentially moving upper and lower belts, to distribute the bituminous substance as a lining.

13. Apparatus for centrifugally lining
 15 iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of parallel, endless power driven roller chains moving in the same sense, a plurality of parallel, endless, power driven
 20 belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a separate power driven lower belt extending around
 25 each roller chain with its upper stretch resting slackly thereon, means for feeding the pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, the pipes being translated
 30 bodily by the progression of said hollows wherein they are simultaneously spun about their own axes by the coaction of the differentially moving upper and lower belts, to distribute the bituminous substance as a
 35 lining, and mechanism for moving the upper belts bodily towards and away from the lower belts.

14. Apparatus for centrifugally lining
 40 iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of parallel, endless, power driven roller chains moving in the same sense, a plurality of parallel, endless,
 45 power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a separate power driven lower belt extending
 50 around each roller chain with its upper stretch resting slackly thereon, means for feeding the pipes charged with liquid bituminous substance on to said lower belts which sag thereunder and form hollows between
 55 the rollers of the chains, the pipes being translated bodily by the progression of said hollows, wherein they are simultaneously spun about their own axes by the co-action of the differentially moving upper and lower belts,
 60 to distribute the bituminous substance as a lining, mechanism for moving the upper belts bodily towards and away from the lower belts, and means for cooling the pipes while still being spun.

65 15. Apparatus for centrifugally lining

iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of parallel, endless, power driven roller chains moving in the same sense, a plurality of upper parallel, endless power driven belts moving in the same sense and so that
 70 their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting
 75 slackly thereon, a number of parallel endless bands forming a conveyor for feeding the charged pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated
 80 bodily while being spun about their own axes by the co-action of the differentially moving upper and lower belts, and stationary ramps on to and over which the pipes are carried for charging with the liquid bituminous substance before spinning.

16. Apparatus for centrifugally lining
 90 iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of parallel, endless, power driven roller chains moving in the same sense, a plurality of upper parallel, endless, power driven belts moving in the same sense and so
 95 that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a separate power driven lower belt extending around each roller chain with its upper
 100 stretch resting slackly thereon, a number of parallel endless bands forming a conveyor for feeding the charged pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by
 105 the progression of which hollows the pipes are translated bodily while being spun about their own axes by the co-action of the differentially moving upper and lower belts, stationary ramps on to and over which the
 110 pipes are carried for charging with the liquid bituminous substance before spinning, and mechanism for moving the upper belts bodily towards and away from the lower belts.

17. Apparatus for centrifugally lining
 115 iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of parallel, endless, power driven roller chains moving in the
 120 same sense, a plurality of upper parallel, endless power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of
 125 the chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, a number of parallel endless bands forming a conveyor for feeding the charged pipes on
 130

to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated bodily while being spun about their own axes by the co-action of the differentially moving upper and lower belts, stationary ramps on to and over which the pipes are carried for charging with the liquid bituminous substance before spinning, mechanism for moving the upper belts bodily towards and away from the lower belts, and means for cooling the pipes while still being spun.

18. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of parallel, endless, power driven roller chains moving in the same sense, a plurality of upper parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, means for feeding the pipes charged with bituminous substance in liquid condition on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated bodily while being spun by the co-action of the differentially moving upper and lower belts, supports for the upper belts and housings in which said supports are slidable so that the supports can be moved together to move the upper belts bodily towards and away from the lower belts.

19. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of parallel, endless, power driven roller chains moving in the same sense, a plurality of upper parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of the chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, means for feeding the pipes charged with the liquid bituminous substance on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated bodily while being spun by the co-action of the differentially moving upper and lower belts, supports for the upper belts, housings in which said supports are slidable so that the supports can be moved together to move the belts bodily towards and away from the lower belts, and means for cooling the pipes while still being spun.

20. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising a plurality of parallel, power driven, endless roller chains moving in the same sense, a plurality of upper parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of said chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, a number of parallel, endless bands forming a feed conveyor for feeding the charged pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated bodily while being spun about their own axes by the co-action of the differentially moving upper and lower belts, stationary ramps on to and over which the pipes are carried for charging with liquid bituminous substance before spinning, supports for the upper belts, and housings in which said supports are slidable so that the upper belts can be moved bodily towards and away from the lower belts.

21. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of parallel, power driven, endless roller chains moving in the same sense, a plurality of upper parallel, endless, power driven belts moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of said chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, a number of parallel, endless bands forming a feed conveyor for feeding the charged pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated bodily while being spun about their own axes by the co-action of the differentially moving upper and lower belts, stationary ramps on to and over which the pipes are carried for charging with the liquid bituminous substance before spinning, supports for the upper belts, housings in which said supports are slidable so that the upper belts can be moved bodily towards and away from the lower belts, and means for cooling the pipes after lining and while still being spun.

22. Apparatus for centrifugally lining iron and steel pipes when charged with a liquid bituminous substance, comprising means for heating the pipes before being charged, a plurality of parallel, power driven, endless roller chains moving in the same sense, a plurality of upper parallel, endless, power driven belts

moving in the same sense and so that their lower stretches move above the chains with a linear velocity different from that of the upper stretches of said chains, a separate power driven lower belt extending around each roller chain with its upper stretch resting slackly thereon, a number of parallel, endless bands forming a feed conveyor for feeding the charged pipes on to said lower belts which sag thereunder and form hollows between the rollers of the chains, by the progression of which hollows the pipes are translated bodily while being spun about their own axes by the coaction of the differentially moving upper and lower belts, stationary ramps on to and over which the pipes are carried for charging with the liquid bituminous substance before spinning, supports for the upper belts, housings in which said supports are slidable so that the upper belts can be moved bodily towards and away from the lower belts, and means for spraying water upon the pipes after lining and while still being spun.

25 In testimony whereof I affix my signature.
CHARLES G. ATHA.