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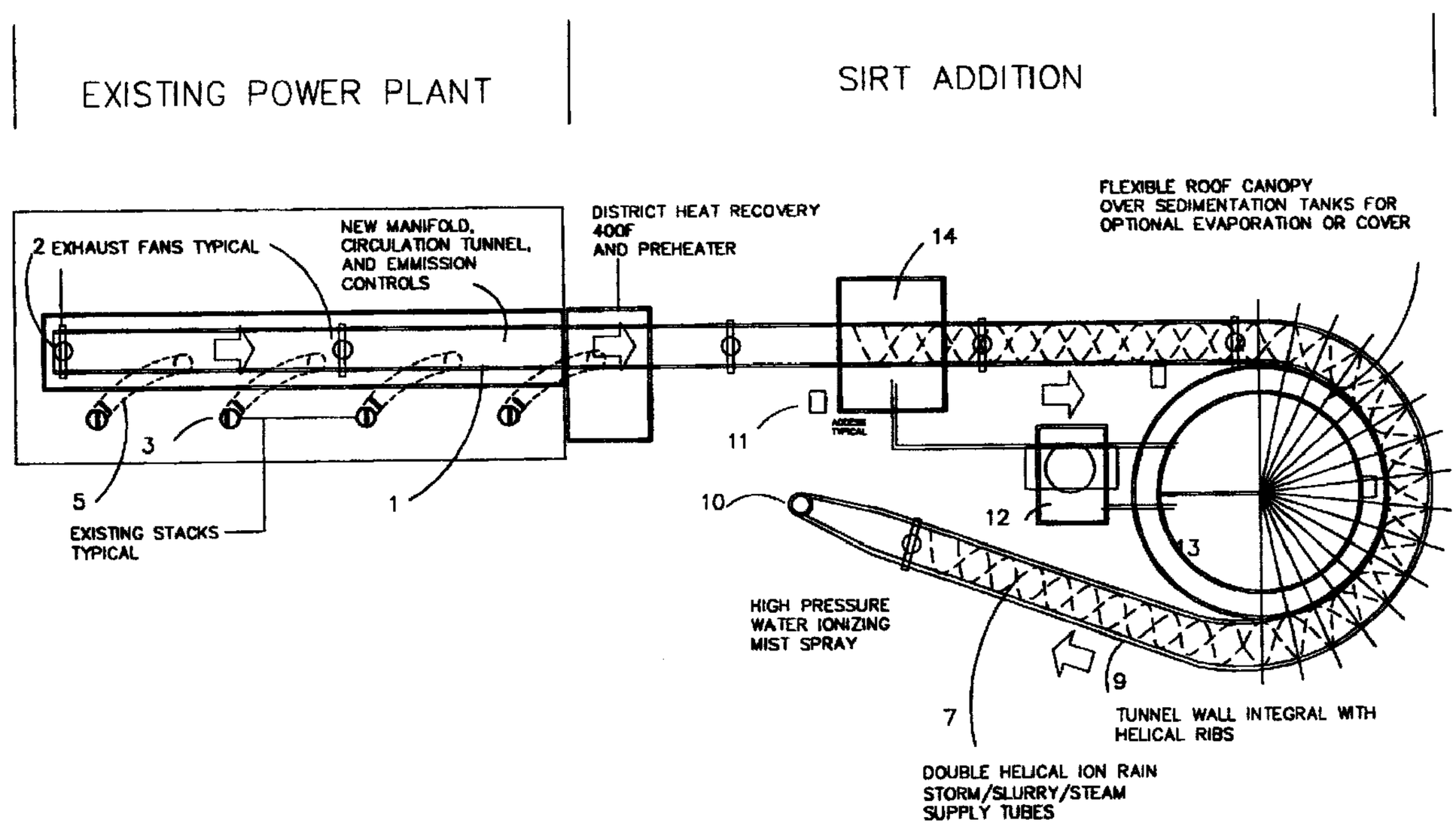
(54) Titre : SIRT (SCRUBBING IONIZED RAIN TUNNEL)
(54) Title: SCRUBBING IONIZED RAIN TUNNEL (S.I.R.T.)



PLAN S.I.R.T HELICAL RAIN
STORM TUNNEL

(57) Abrégé/Abstract:
Simplified method for scrubbing exhaust gas streams to achieve Zero Emissions and with particular utility in Coal Fired Electricity Generation using the Natural State Hydrologic Cycle Emulator. Also described as the Scrubbing Ionized Rainstorm Tunnel (S.I.R.T.) or Rain Tunnel.

"The Rainstorm Tunnel"

Abstract

Simplified method for scrubbing exhaust gas streams to achieve Zero Emissions and with particular utility in Coal Fired Electricity Generation using the Natural State Hydrologic Cycle Emulator. Also described as the Scrubbing Ionized Rainstorm Tunnel (S.I.R.T.) or Rain Tunnel.

Background of the Invention

Coal is the most abundant and easily recovered form of energy source currently extant for all of the world's countries irrespective of their level of technological advancement and so is employed for power generation wherever it is feasible. Coal powered electricity generation emits huge quantities of CO2 into the atmosphere and so coal is one of the biggest contributors to greenhouse gas emissions and therefore global warming. Coal burning also emits acid rain components (NOx & SOx) and toxic heavy metals (Hg & U). The present invention simplifies the process of

recovering and/or sequestering of ***all*** toxic and greenhouse gas emissions far more inexpensively than all other prior apparatus and methods.

An additional benefit of the present method is the recovery of waste heat that is usually vented to the atmosphere, for district heating or local industrial processes furthering efficiency of the Rainstorm Tunnel at eliminating greenhouse gas emissions.

Invention Summary

The chief utility of the invention is its unique design that allows for:

1. dramatically reduced construction and operating costs
2. ease of maintenance
3. ease of scalability
4. penultimate scrubbing control device efficiency

The invention can consist of either a single tunnel or have multiple tunnels run in series or parallel and each to any length depending on the volume of the effluent and the configuration of the power plant/effluent generating process and/or its site. The chief efficiency of the invention comes from the use of **ionized water** in a tunnel with

spray nozzles, but **any scrubbing agent** extant can be used depending on the constituent contamination of the effluent gas and how close to 'zero emission' it is desired that any specific installation of "The Rainstorm Tunnel" process needs to be.

The Key to the invention is its emulation and compression of the Hydrologic Cycle in its operation. In nature the Hydrologic Cycle uses chiefly heat, gravity, electrical discharges (lightning) and precipitation to cleanse the air. The vortices created due to wind forces of a storm combined with the resident time of particulates within moisture-laden environments add to the cleansing and purifying of pollutant air. The Rainstorm Tunnel compresses the effects of the larger natural environment into an overall linear controlled environment to carefully control all variables for maximum efficiency. The device scrubs the effluent with a pressurized rain/spray that absorbs the toxic constituents and is collected by gravity and pumped to a settling tank to precipitate the fly ash. The liquor effluent is then received in an electro-coagulation tank to collect the remaining dissolved toxic metals and oxides of sulfur and nitrogen. The laminar flow effect in the tunnel sees some gas moving by spray force and by tunnel shape in helical motion along the outer edges of the tunnel, while gases in the center are seen as traveling at different velocities and targeted to be spray-blown into the

ponding sections at the base of the tunnel to be further mixed with the outer streams. Additional vortices created are the effects of the central flow folding into the outer flows at approximately the inner most edge of the helical fence/rib version or varying the orientation of the spray nozzles along the length of the tunnel. The chaotic or non-chaotic result of gas volume factors ratio to helical wavelength and amplitude factors are calculated depending on the volume and constituency of the effluent stream using present day understandings of vortex design, absorption factors due to gas pressure, distance and time traveled within control device, material surface texture and area, and variables relating to the introduced agent properties. It is the intention of the Rainstorm Tunnel that a degree of the momentum of the swirling action within a helical vortex is maintained to provide a continuous and maximal surface absorption, velocity and residence time as in nature as apposed to other methods of screening, filtering, catalytic chemical reductions, combustion modifications, and precipitating that require significantly more process energy and often require complete retooling of existing power plants. The Rainstorm Tunnel can eliminate or reduce the size of dust collectors, the need for coal preparation prior to burning, lime input for SO2 scrubbing, bag-houses, electrostatic precipitators, complex multiple grid piping systems, pure oxygen and low nitrogen combustors

and the attendant maintenance problems. The Rainstorm Tunnel using custom designed spray nozzles to create optimal droplet sizes and GWPT's proprietary Nozzle Auto-Positioning & Retrieval System (NAPRS) for ease of maintenance can accommodate varying coal fired plant layouts and effluent stream volumes and constituents with ease and flexibility. Because of this flexibility and simplicity, due to its artful design, the Rainstorm Tunnel can also be segmented and portable to a degree impossible with other systems of screening and filtering and settling.

Detailed description of the drawings

In accordance with the present invention briefly described herein Figure 2 shows a greatly simplified system for removing all toxic constituents of any gaseous effluent stream at any temperature with or without heat exchangers (6) via spray nozzles (15), using ionized water, steam or slurry spray introduced artfully into a sloped or horizontal tunnel to create a vortex in the exhaust stream thereby increasing its dwell time in the spray. The helical interior shaped version (Figure 3) creates ideal conditions to maximize the spray contact time with the exhaust stream. The single, double or triple helical fence/rib (7) embodied in the present invention minimizes construction complexity and cost as the fence/rib integrally strengthens the Rainstorm Tunnel's

structure. Figure 3 shown represents a single helix, high fence & high frequency configuration. An actual tunnel variation may incorporate as little as one or a multiple of helical grooves/fences along the tunnel surface made of stainless steel with welded on rebar or other high strength/ high temperature resistant concrete/plastic/composite material to become integral with a formed concrete/plastic/composite tunnel and drains therein to act as ponding and collection devices. A Rainstorm Tunnel version having only spray nozzles (Figures 4a, 4a1, 4b, 4b1) will impart the beneficial vortex, centrifugal and ponding effects without the impediment of a fence by having the piping on the outer periphery of the walls of the tunnel with some of the nozzle heads extensible into the very centre of the tunnel to penetrate the central vortex created in the tunnel using the Nozzle Auto-Positioning & Retrieval System (NAPRS). Figures 4b & 4b1 illustrate a tunnel section and enlargement of the Nozzle Auto-Positioning & Retrieval System (NAPRS). Illustrated in Figure 4b1 is the detail of the installed aspect of the NAPRS hydraulic spray-head moving device. Ionized water enters through main pipes (16b) which connect to the distribution pipes (17) which are held to the exterior of the SIRT by clamps (26) bolted to brackets (19) welded to a plate (24) which is bolted to the SIRT wall (9). The distribution pipes (17) feed pressurized ionized water to the connected feeder pipes (18)

through the telescoping hydraulically operated feeder pipe extension (22) that penetrates the SIRT wall(9) and its liner(25) moving through a sleeve (23) to position the spray head (15) The hydraulic fluid is fed by hoses(37) and the moving feeder pie extension(22) and the feeder pipe(18) are held to the brackets by bolts (21).

Helical fencing (Figure 3) for certain applications may be constructed from identical modules arranged along a given calculated path for each particular application, and may move through various frequencies within the path length. The high pressure spray nozzles (15) that are arrayed along the fence/rib or embedded in the walls of the tunnel can be angled to impart radial and axial momentum to the effluent gas, and may be positioned alternatively in any location along the tunnel wall being fed from supply pipes running longitudinally or spirally inside, outside or embedded in the tunnel wall. This advantageously results in a decrease in the necessary size and power of the induced draft fans as the gas will mix and flow naturally by the vortex created by the fence/rib and the spray and causing a natural centrifuge effect. Illustrated is the advantageous embodiment of the invention wherein the axial cross sectional Figure 1 shows induced draft fans (2) moving exhaust gas into a downward sloped tunnel (7), in which heat exchangers (6) can be installed to create process steam for steam stripping of volatile gases

and sulfurs and/or heat removal for district heating/industry plus the necessary preheat of the ion spray and reheating of the effluent gas discharged to the atmosphere if desired. The Rainstorm Tunnel can also enter the ground to take advantage of ground source cooling.

Subsequently the new stack dimensions are dramatically reduced and therefore have less impact on the local esthetics. The initial parts of the tunnel can contain, in the case of a coal fired generating station, a series of helically shaped or standard heat exchanger pipes (6) to preheat the slurry or ionized water and/or create steam to be used in steam stripping volatiles from the effluent gas, the configuration of which will depend on the constituent effluent gas. From the initial stage the tunnel proceeds to a to a chamber (14) in which the initial highly concentrated liquor is collected to be pumped to sedimentation tanks (13) and then to electro-coagulation processing (12) and/or ozonation or any other existing prior art process necessary to purify the liquor and its off-gas. From the chamber the tunnel proceeds upward and can contain one and as many as three helical fence/ribs (7) positioned spirally along the tunnel wall and such ribs have advantageously spaced spray nozzles (15) along its interior edge to maximize exposure to and dwell time of the exhaust gas in the ionized water or slurry spray and/or steam. Alternatively the nozzles themselves (15) embedded in the tunnel wall can impart a

cyclonic effect by their aspect with some of the nozzle heads extensible into the very centre of the tunnel to penetrate the central vortex created in the tunnel. Alternatively the Nozzle Auto-Positioning & Retrieval System (NAPRS)(4b, 4b1), which the nozzles(15) can be mounted on, can move the feeder pipes(18) telescoping them through the tunnel wall (9) to either hydraulically or manually move them for ease of maintenance and safety of the workers as the workers would never have to enter the tunnel nor the tunnel shutdown for maintenance (Figure 6). The resultant is a controlled linear cyclonic rainstorm. Parameters will include a sound wave analysis to avoid potential reverberation resulting in sound and if deemed necessary reverse wave sound deadening equipment installed (noise canceling). The ribs can also act as heat exchangers if so desired by embedding piping within them or eventuating them as pipes illustrated in Figure 3. The feeder pipes(18) for the spray nozzles (15) are modularized and sectioned off for ease of maintenance. The helical fence/rib in the sloped or horizontal tunnel (9) creates multiple natural collection points/pools as temporary storage of the liquor in the tunnel which then can be siphoned to the main drains (8) and once the concentration of contaminants in the runoff liquor has reached the desired level then the liquor can be piped away for further

processing. The resultant purified exhaust is released to the atmosphere via the vent stack (10).

Note:

In the helical rib design (Figure 3) each drain (8) will contain diminishing concentrations of contaminants and/or completely different contaminants both in relation to the increasing distance along the tunnel from the source of the coal smoke and what is being sprayed into the tunnel at that particular point, as both can vary to the constituents of the effluent, which would allow differing levels of further processing as the liquor at every drain (8) would not need every step of the purification process (as at each collection point the concentration and/or makeup of the runoff liquor varies and this can create diminishing returns for effort expended to cleanse the liquor). The last few drains (8) can simply have their thinly contaminated liquor returned to the first few spray nozzles allowing for much more efficient reuse of the cleansing spray as it does not have to be processed to complete purity before being reused. Only liquor that has the highest concentration of contaminant needs to be piped away for further processing by electro-coagulation, electro flocculation, precipitate settling, aeration or sequestration depending on the constituent toxicity.

In simplified versions of the tunnel for effluent streams that are not highly contaminated or for small volumes of effluent the helical ribs can be eliminated and the distribution pipe itself (16,16b) can either be shaped in a helical or straight-line configuration. In applications where a very high pressure of ionized rain or scrubbing slurry mixture is needed as in a coal fired exhaust stream, the feeder pipe can be mounted inside the tunnel walls with only the spray heads exposed to the effluent in a helical or straight-line fashion or attached to the inside of the tunnel walls (Figure 5), such design placement and materials used dependant on the toxicity and corrosiveness of the effluent. In the case of a coal fired power plant the fly ash would be settled out in a pond, tank or optimally in the bottom of the tunnel(12) and the resultant liquor further processed via electro coagulation(13) to remove the Sulfates and Nitrates that are the base in smelters, incinerators and other high emission processes. Nox reduction in the effluent can take place before, during or after the Rainstorm Tunnel. Should the process be taken to its final and penultimate stage the carbon dioxide in the exhaust gas from the coal fired power plant or any other effluent stream, could be sprayed with a calcium and enzyme mixture for further sequestration as carbonate. The tunnel maintains a closed loop and processes the resultant liquor until the

water is pure enough to be reused in the tunnel. Dwell time and mixing in the tunnel and therefore contact time to the spray is varied to the toxicity, temperature and density of the effluent gas by increasing or decreasing one of the following variables including but not limited to:

a) The fence / rib height
b) The slope of the tunnel
c) The length of the tunnel
d) The diameter of the tunnel
e) The coil tightness (frequency) of the rib along the tunnel wall
f) The density of the spray nozzles
g) The orientation of the spray nozzles
h) The pressure of the spray
i) The number of fences coiled about one another on the tunnel wall
j) The constituents of the spray
k) The size of the spray droplets
l) Surface texture on fence/ribs and tunnel wall
m) Periodically reversing or changing the aspects of the fence/rib coil on the tunnel wall
n) Eliminating the fence/rib
o) Helical arrangement of the spray nozzles/pipe
p) Straight-line arrangement of the spray nozzles/pipe
q) Materials and design of the spray nozzles/pipe
r) Positioning of the spray nozzles/pipe in the vortex
s) Embedding the pipe in the tunnel wall
t) Attaching the pipe to the tunnel wall
u) Materials and design of the tunnel
v) Sealing the tunnel and batching the effluent to increase dwell time
w) Any combination of the above

LIST OF FIGURES

It is understood that various other embodiments and modifications in the practice of the invention will be apparent to, and can be readily made by, those skilled in the art without departing from the scope and spirit of the invention described above. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the exact description set forth above, but rather that the claims be construed as encompassing all of the features of patentable novelty which reside in the present invention, including all the features and embodiments which would be treated as equivalents thereof by those skilled in the art to which the invention pertains. The ionized water spray main supply pipes may be introduced along the tunnel length (16 & 16b) in any number and have branched piping into the tunnel at various intervals to effect the desired the result contained herein.

Claims

1) A Rainstorm style of cleansing apparatus for purifying effluent streams of gases comprising:

a first exhaust pipe (Figure 2) having an inlet for introducing effluent gases being purified and an outlet for discharging purified gases to the atmosphere or sequestration with artfully designed spray nozzles and piping to introduce an effluent scrubbing spray;

a first heat exchanger (6) consisting of at least two separate

systems of piping the first for removing heat to reheat the purified exhaust stream of carbon dioxide for dispersion to the atmosphere if sequestration is not desired and the second for preheating the purifying spray before introduction into the tunnel through first a main supply pipes (16 , 16b) then distribution pipes(17) and finally feeder pipes(18) with nozzles(15) at their terminus, such piping artfully designed to have either a spiral aspect or straight line configuration within the tunnel and/or embedded in fences/vortex generators depending on the specific application of The Rainstorm Tunnel;

tanks and/or hoppers with valves and metering equipment ,whose design is known to those with ordinary skill in the art, to supply said purifying substances;

connected to the tanks/hoppers a plurality of main supply pipes , either in series or parallel, that run through the second set of heat exchangers;

connected to the main supply pipes ,distribution pipes , either in series or parallel, connected in such a way to supply said purifying substances to the feeder pipes;

feeder pipes ,connected to the said distribution pipes, extending through the tunnel wall artfully designed to telescope

back and forth through the tunnel wall, automatically positioned and retrieved to provide access to the nozzle heads, either hydraulically or in the case of failure of the hydraulics ,manually, for ease of maintenance and safety of the workers as the tunnel will never have to be shut down unless desired, nor the workers exposed to the exhaust stream or its resultant residue in the tunnel;

a plurality of nozzles located at the terminal of said feeder pipes to spray purifying substances into the exhaust stream, such substances sprayed and/or artful location and design of the nozzles and their aspect dependant on the volume, temperature and constituents of the effluent gas and it's suspended particulates as all will vary from one specific application to the next;

pumps and valves ,whose design is known to those with ordinary skill in the art, located before, after or along the main supply pipes to move and pressurize the said purifying substances for delivery to the distribution pipes and feeder pipes;

a first sump drain or plurality of sump drains located in the bottom of the tunnel to drain said purifying substances now contaminated with effluent from the tunnel;

connected to the sump drains a pipe or plurality of pipes with

metering equipment , valves and pumps, whose design is known to those with ordinary skill in the art, for carrying said contaminated purifying substances away for further processing, such processing to be dependant on the constituent contaminants and generally known to those with ordinary skill in the art;

a plurality of vortex generators and/or fences and/or piping artfully located within the tunnel to create a vortex within the exhaust stream thereby increasing the dwell time and the path length of the effluent increasing the efficiency of the scrubbing spray ;

2) A Rainstorm Tunnel as described in Claim 1 with particular utility for mitigating or completely eliminating toxic and greenhouse gas releases from coal fired electricity generation comprising;

a first exhaust pipe (the Rainstorm Tunnel) having an inlet for introducing coal smoke with a blowback damper valve to suppress blowback during the startup phase of the coal furnace, such damper design known to those with ordinary skill in the art ,and outlets for a) discharging purified carbon dioxide to the atmosphere and/or b) an outlet to a chamber/tank for compression of purified carbon dioxide to provide a raw material for further industrial uses and/or c) an outlet to a further Rainstorm Tunnel or

tunnels in series or parallel from the first tunnel with all of the same attributes of the first tunnel as described herein, for sequestration of the carbon dioxide by spraying a mixture of enzymes and calcium to create limestone for use as a raw material for further industrial uses and/or d) any combination of said outlets as desired or e) a closed ended tunnel to increase dwell time and to allow for either complete capture and compression of the carbon dioxide or sequestration of the carbon dioxide as limestone;

a first heat exchanger (Figure 1 (6)) consisting of at least two separate systems of piping the first for removing heat to reheat the purified exhaust stream of carbon dioxide for dispersion to the atmosphere if sequestration is not desired and the second for preheating the purifying spray before introduction into the tunnel through distribution and feeder pipes, such piping artfully designed to have either a spiral aspect or straight line configuration within the tunnel and/or embedded in fences/vortex generators;

tanks and/or hoppers with valves and metering equipment ,whose design is known to those with ordinary skill in the art, to supply said purifying substances ;

connected to the tanks/hoppers main supply pipes , either in series or parallel, that run through the second set of heat

exchangers in or on later areas of the tunnel ultimately connected to nozzles to deliver the preheated scrubbing spray into the coal smoke exhaust stream,

distribution pipes as a continuation of the main supply pipes artfully designed mounted either on the outer periphery or embedded in the walls of said first exhaust pipe/tunnel (Figure 5(5a)) and/or on the fences and/or on the vortex generators and/or the design and location of the pipes themselves artfully located to produce a vortex in the exhaust stream;

a plurality of feeder pipes connected to the said distribution pipes extending through the tunnel wall artfully designed to telescope back and forth through the tunnel wall ,either hydraulically or manually in the case of failure of the hydraulics for ease of maintenance and the safety of the workers as the tunnel would never have to be shutdown unless desired or the workers even enter it to change the nozzle heads on the end of the feeder pipes if they became eroded/clogged and/or require modification/upgrading ;

a plurality of nozzles located on the terminus of said feeder pipes, to spray purifying substances into the exhaust stream, in the first areas of the tunnel the spray will consist of purified ionized

water to absorb the greatest amount of heavy metal containing fly ash ,noxious nitrates, sulfates, hydrogen flouride and other volatile organic compounds ; in later areas of the tunnel series the substances sprayed could consist of slurries of calcium and enzymes to sequester the excess carbon dioxide as limestone, such variation and combination of sprays dependant on the volume, temperature and constituents of the effluent gas and it's suspended particulates as they vary along the length of the tunnel and whether total sequestration of the resulting purified stream of carbon dioxide is desired , said nozzles having angles and aspects artfully aimed to produce a both vortices in the coal smoke and to wash the walls/fences/vortex generators within the tunnel ;

magnetic or electric water ionizing apparatus ,known to those of ordinary skill in the art, around or within the said main supply pipes to ionize the water within them;

a first sump drain or plurality of sump drains located in the first areas of the tunnel at the bottom of the tunnel to drain said ionized water ,now contaminated with fly ash and heavy metals from the coal smoke in the tunnel, artfully designed to drain from differing parts of the tunnel the contaminated ionized water which will have varying densities and constituents of contamination the

further away they are drained from the tunnel inlet and the source of the coal smoke; for efficient processing to reduce costs and complexity should it be desired in any particular application with utility and art varying to the unique design of, and constituents of the particular coal burned in any one individual coal fired electrical generation plant , as both vary from one plant to the next;

connected to the sump drains in the first areas of the tunnel a pipe or plurality of pipes for carrying said contaminated ionized water away to settling tanks/ponds whose design is known to those with ordinary skill in the art, to separate the fly ash from the ionized water

connected to the settling tanks/ponds a pipe or plurality of pipes to carry away the contaminated ionized water for sedimentation and/or electro-coagulation and/or electro-flocculation and/or membrane filtering and/or sand filtering processing to remove the heavy metals, nitrates, sulfates and volatile organic compounds, such processing to be dependant on the constituent contaminants and known to those with ordinary skill in the art;

a plurality of vortex generators and/or fences and/or piping artfully located within the tunnel to create a vortex within the

exhaust stream thereby increasing the dwell time and the path length of the effluent increasing the efficiency of the scrubbing spray ;

3) A Rainstorm Tunnel as described in Claims 1&2 segmented and erected on railroad bogies or highway floats, for ease of transport and/or mobility on site for as the coal fired plants the mobile tunnels are associated with become obsolete and are decommissioned the segmented tunnels can be economically moved and reused without losing the capital investment in their construction.

4) A Rainstorm Tunnel as described in Claims 1,2&3 that has superior characteristics of flexibility of application, ease and economy of construction and operation superior to any of the more complex pollution mitigation methods and apparatus existing previously in coal fired electricity generation plants.

5) A Rainstorm Tunnel as described in Claims 1,2,3&4 that eliminates the expense and complexity of coal preparation, to reduce its sulfur content, in coal fired electricity generation plants.

6) A Rainstorm Tunnel as described in Claims 1,2,3,4&5 that eliminates the expense and complexity of baghouses for fly ash separation in coal fired electricity generation plants.

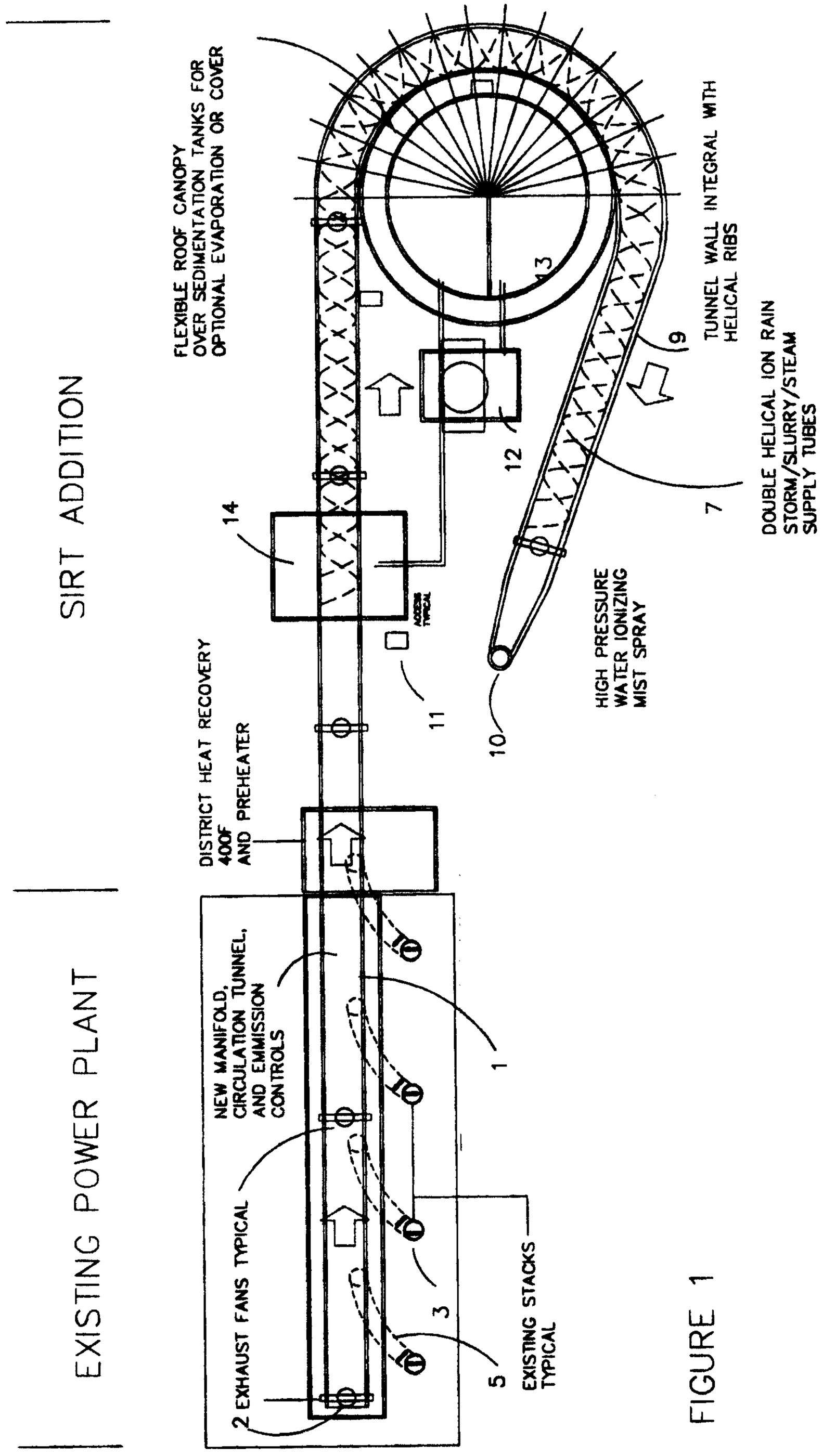
7) A Rainstorm Tunnel as described in Claims 1,2,3,4,5&6 that eliminates the expense and complexity of fluidized bed combustion of coal to mitigate sulfur release.

8) A Rainstorm Tunnel as described in Claims 1,2,3,4,56,&7 that eliminates the expense and complexity of low nitrogen burners for the combustion of coal to mitigate Nox release.

9) A Rainstorm Tunnel as described in Claims 1,2,3,4,5,6,7&8 that eliminates the expense and complexity of pure oxygen burners for the combustion of coal to mitigate Nox release.

10) A Rainstorm Tunnel as described in Claims 1,2,3,4,5,6,7,8 &9 segmented and compartmentalized for ease of replacement of segments or ease of maintenance of segments.

11) A Rainstorm Tunnel as described in Claims 1,2,3,4,5,6,7,8,9 &10 that minimizes the expense and complexity of modifications necessary to existing coal fired electricity generation plants for toxic and greenhouse gas emission mitigation superior in economy to any of the more complex methods existing previously.


PLAN S.I.R.T HELICAL RAIN
STORM TUNNEL
SIRT ADDITION
EXISTING POWER PLANT
FLEXIBLE ROOF CANOPY
OVER SEDIMENTATION TANKS FOR
OPTIONAL EVAPORATION OR COVER
TUNNEL WALL INTEGRAL WITH
HELICAL RIBS
DOUBLE HELICAL ION RAIN
STORM/SLURRY/STEAM
SUPPLY TUBES
HIGH PRESSURE
WATER IONIZING
MIST SPRAY
DISTRICT HEAT RECOVERY
400F
AND PREHEATER
NEW MANIFOLD,
CIRCULATION TUNNEL,
AND EMMISSION
CONTROLS
2 EXHAUST FANS TYPICAL
EXISTING STACKS
TYPICAL
1
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3
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7
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11
12
13
14

FIGURE 1

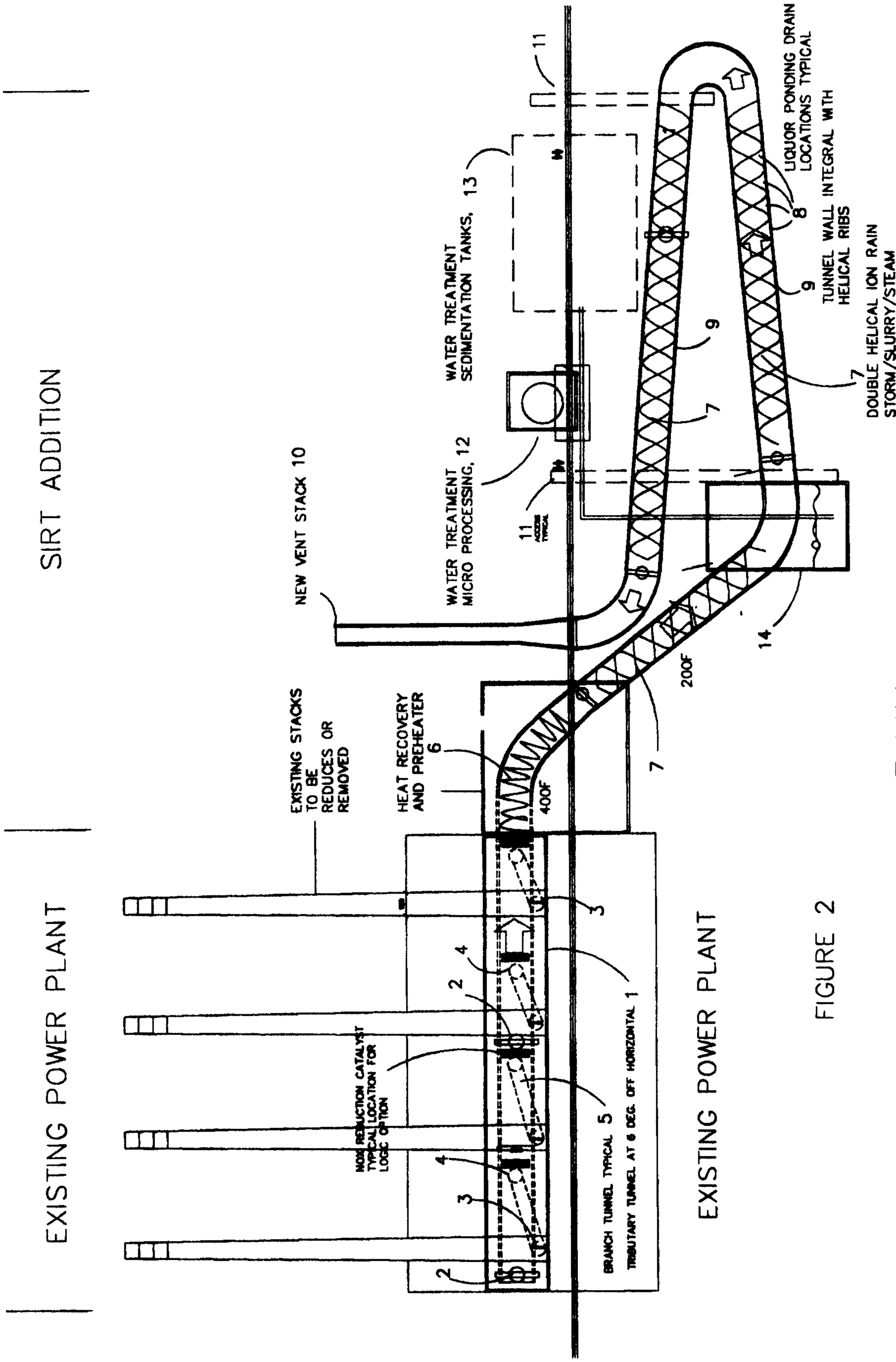


FIGURE 2

SECTION ON S.I.R.T HELICAL RAIN STORM TUNNEL

S.I.R.T. Scrubbing Ionized Radiation Tunnel

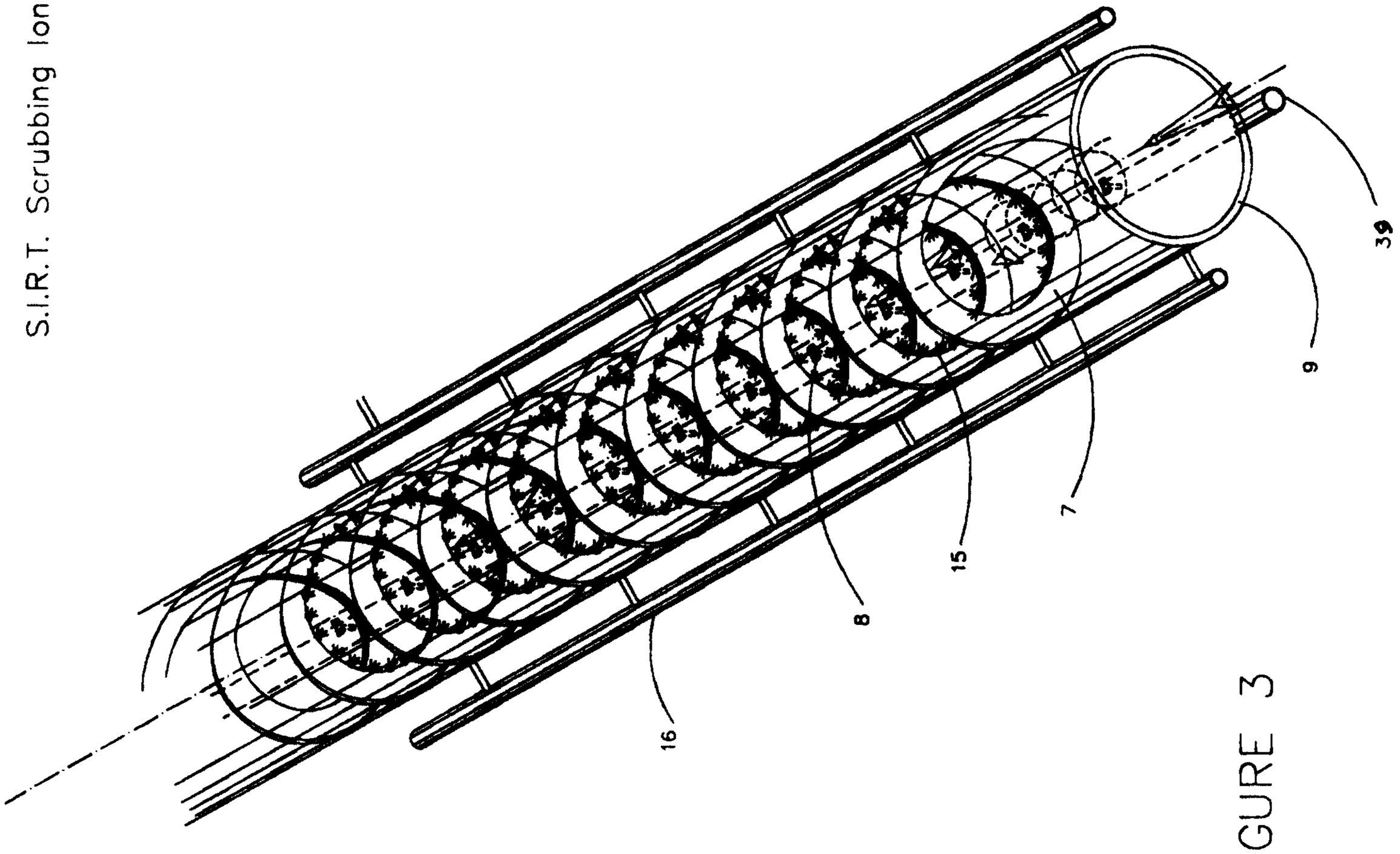
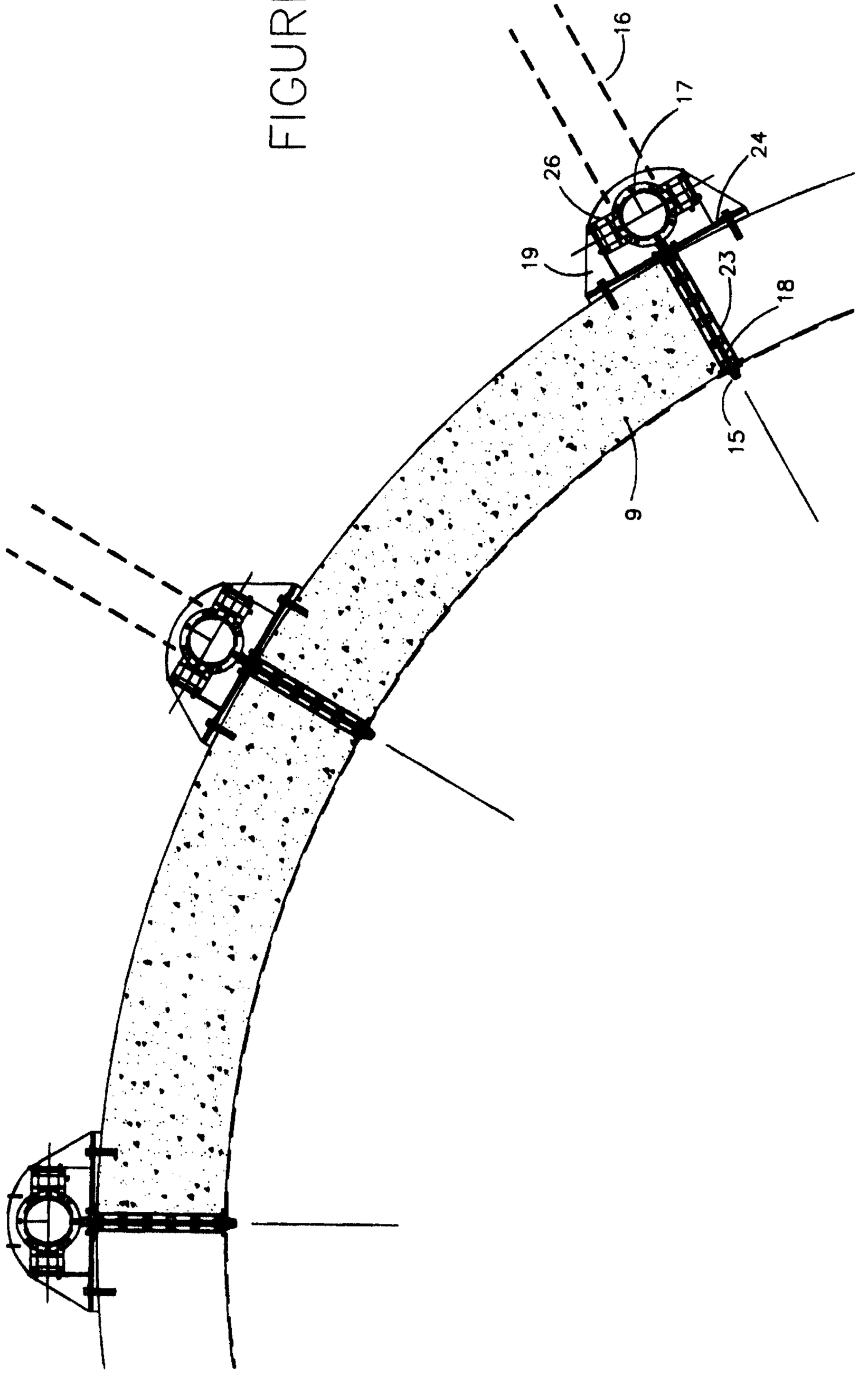


FIGURE 3

S.I.R.T. Scrubbing Ionized Rain Tunnel.

FIGURE 4a



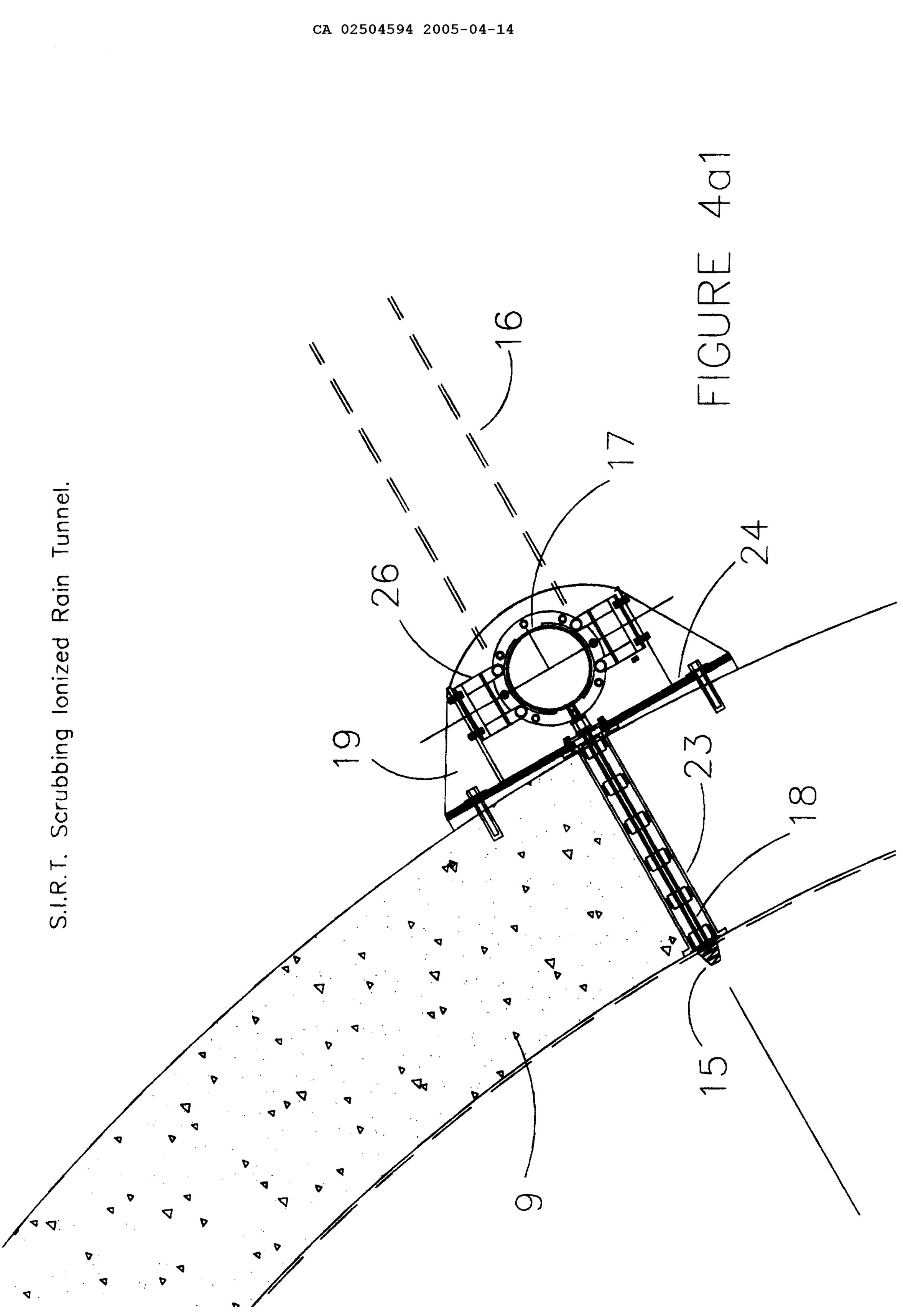


FIGURE 4a1

S.I.R.T. Scrubbing Ionized Rain Tunnel.

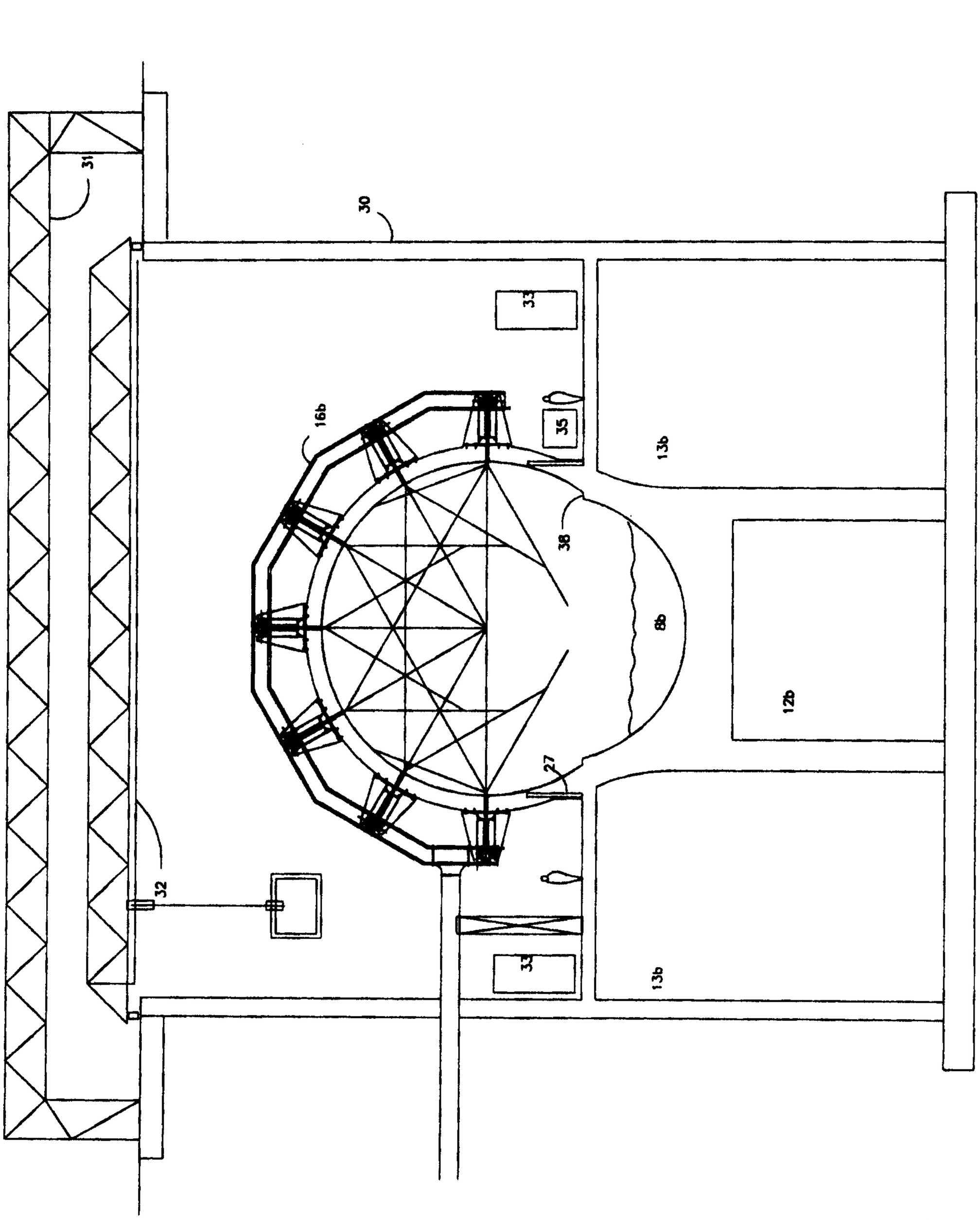
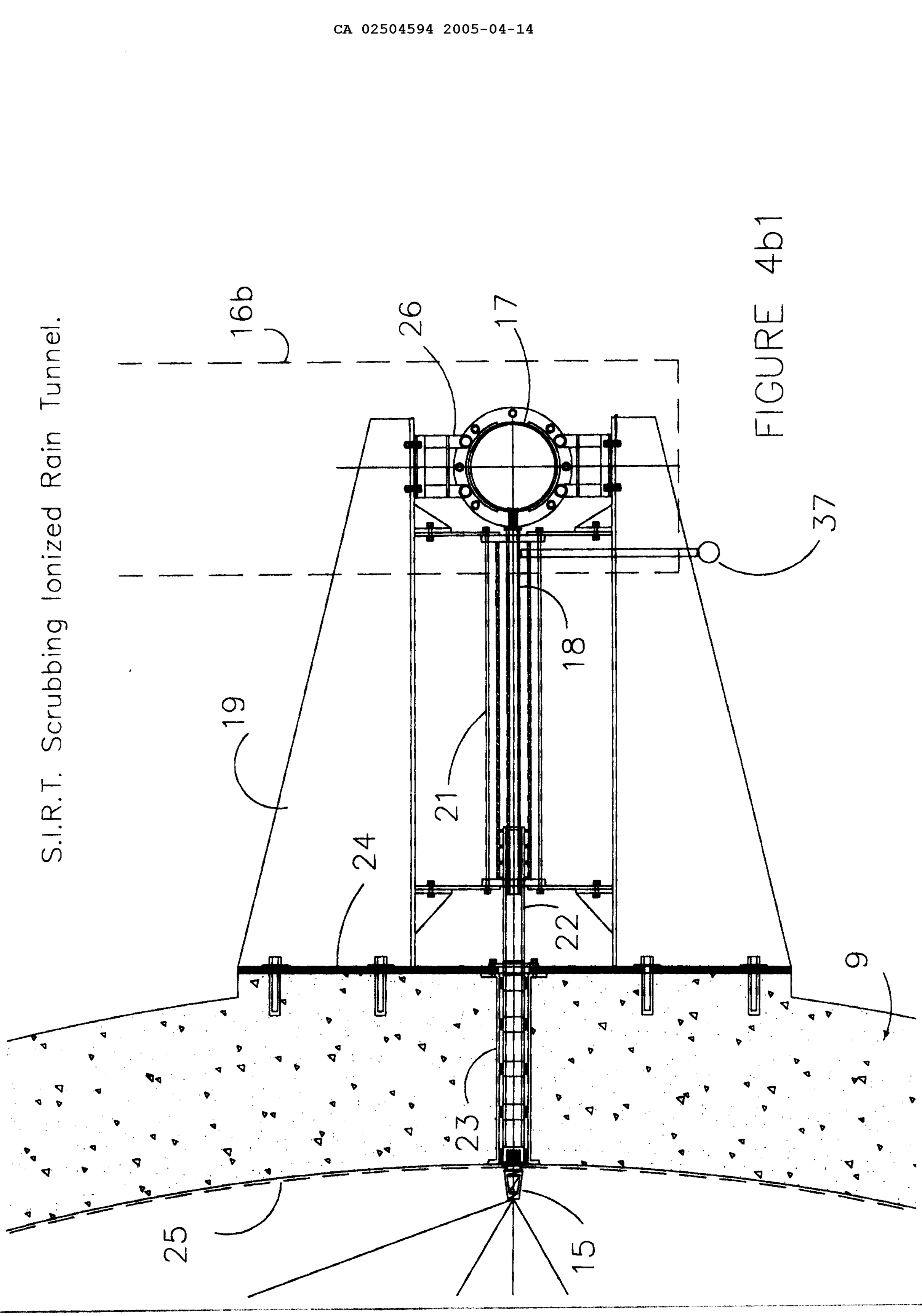
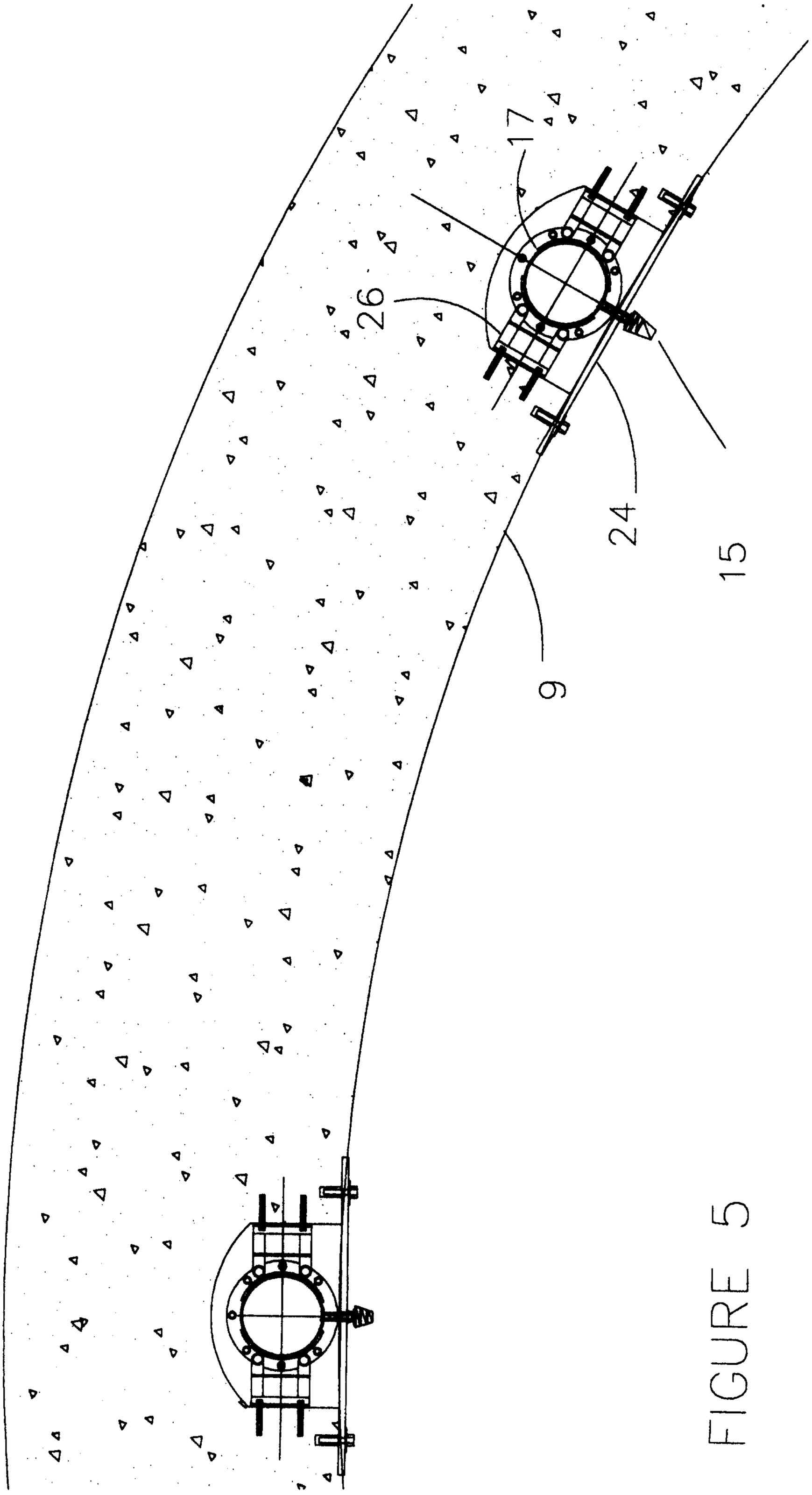


FIGURE 4b


S.I.R.T. Scrubbing Ionized Rain Tunnel.
16b
26
17
18
19
21
24
22
9
23
25
15
37
4b1

FIGURE



S.I.R.T. Scrubbing Ionized Rain Tunnel.

FIGURE 5

S.I.R.T. Scrubbing Ionized Rain Tunnel.

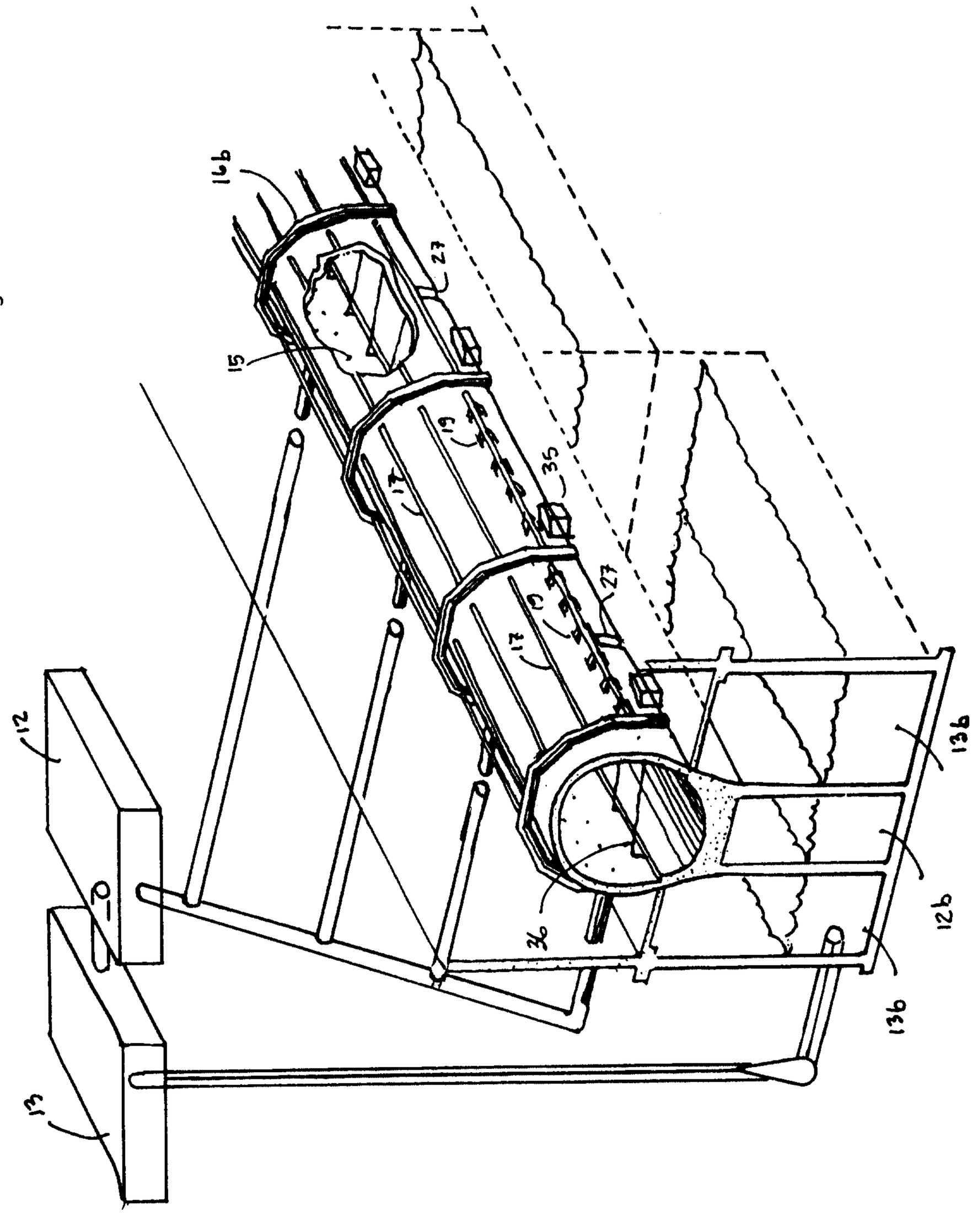
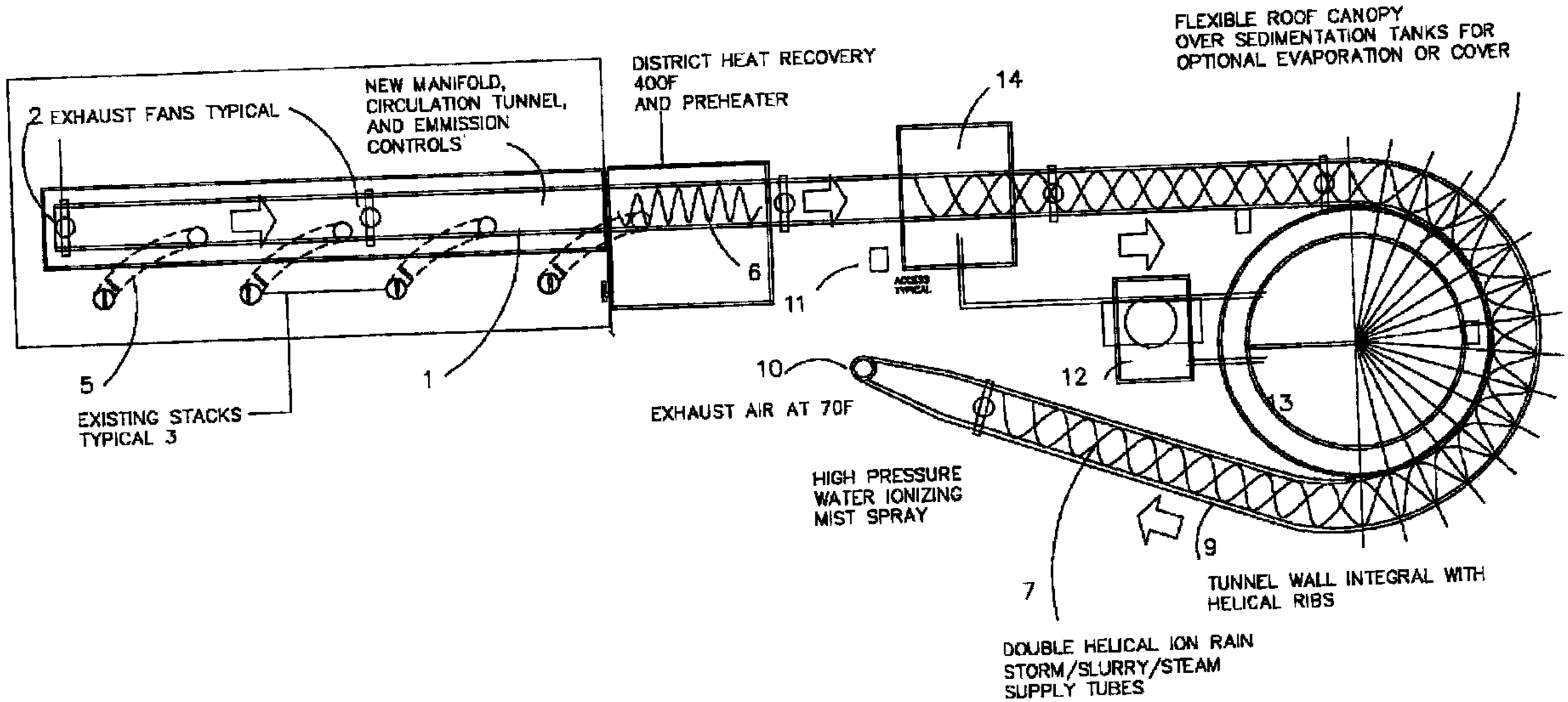


FIGURE 6

EXISTING POWER PLANT

SIRT ADDITION



PLAN S.I.R.T. HELICAL RAIN STORM TUNNEL