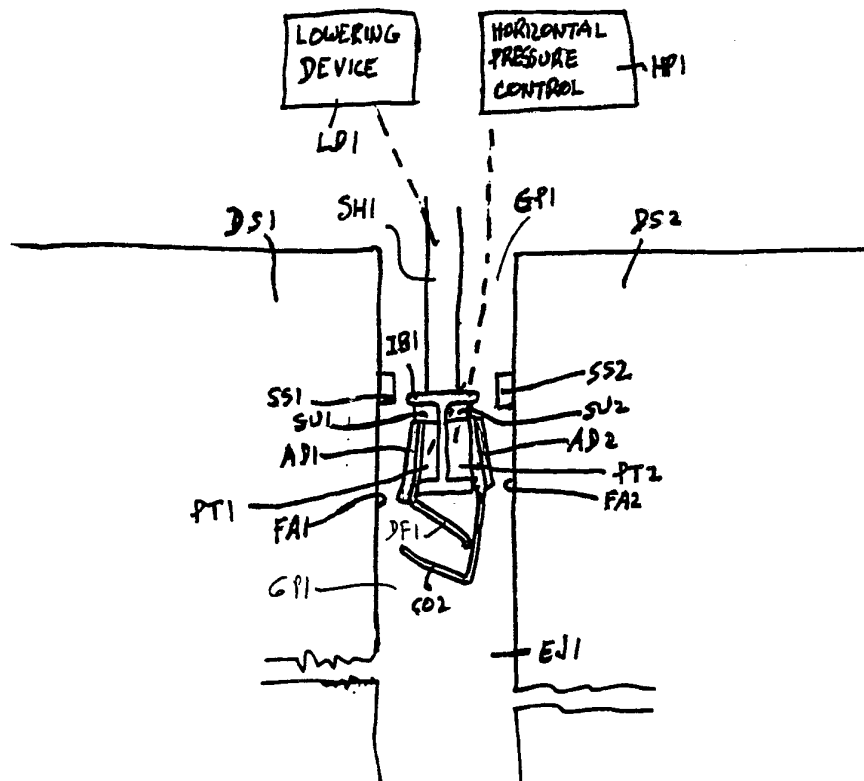




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<p>(21) International Application Number: PCT/US92/09357</p> <p>(22) International Filing Date: 26 October 1992 (26.10.92)</p> <p>(30) Priority data: 07/782,152 24 October 1991 (24.10.91) US 07/834,060 11 February 1992 (11.02.92) US</p> <p>(71) Applicant (for all designated States except US): INFRASTRUCTURE PROTECTION SYSTEMS, INC. [US/US]; 215 Ridgedale Avenue, Florham Park, NJ 07932 (US).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only) : BURKE, Bertram, V. [US/US]; 401 Rt. 22 West, 23-F, Plainfield, NJ 07060 (US). HALL, David [US/US]; 2384 Channing Avenue, Westfield, NJ 07090 (US). BURDETT, Jay [US/US]; P.O. Box 1016, Saratoga Springs, NY 12866 (US).</p>	<p>(74) Agent: STANGER, Leo; Stanger, Stempler & Dreyfus, P.C., 382 Springfield Avenue, Summit, NJ 07901 (US).</p> <p>(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).</p> <p>Published With international search report.</p>	

(54) Title: BACKUP PROTECTION FOR SEALED STRUCTURAL EXPANSION JOINTS



(57) Abstract

A retrofit for diverting water leaking into an elevated expansion joint (EJ1) is formed by lowering an applicator (1B1) that carries an adhesively treated water run-off arrangement (AD1 + AD2) into the joint and pressing the arrangement against inside walls of the joint with an expanding bladder (PT1 + PT2) under fluid pressure. When the adhesive cures, reducing the pressure collapses the bladder (PT1 + PT2) and allows withdrawal of the applicator.

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TITLE**BACKUP PROTECTION FOR SEALED STRUCTURAL
EXPANSION JOINTS****RELATED APPLICATIONS**

5 This is a continuation-in-part of our
pending application Serial No. 653,254, Filed
February 11, 1991. The subject matter of that
application is incorporated into this application as
if recited herein.

10 **BACKGROUND OF THE INVENTION**

 This invention relates to backup
protection for sealed structural expansion joints,
and particularly to retrofitted backup protection of
structural members against water seeping around
15 seals at expansion joints of elevated structures
such as bridges or decks.

 Elevated roadways or decks with steel or concrete-
steel superstructures generally sit on steel
bearings surmounting the caps on top of concrete
20 piers. Such roadways expand and contract
continuously with hourly changes in temperature, as
well as seasonal temperature variations. They also
move in response to other forces. Expansion
joints, forming gaps between sections of roadway
25 that rest on the pier caps, accommodate this

movement, growth, and shrinkage. The expansion joints usually extend transversely across the road, but may also follow longitudinally along the roadway. To prevent run-off water from damaging the supporting piers and caps, the expansion joints include elastically compressible seals secured in the gaps between the roadway sections. These seals shunt most of the water and other liquid materials that accumulate on a roadway away from gaps. The seals themselves resiliently reshape to fill the gaps between the roadway sections.

However, the seals are not perfect. Some of the water, caused by rain and snow, and oils and other materials leaking from automobiles, bypass trickle through the seals. Ultimately these liquids damage the bearings, the caps, and structural piers. Because the resulting damage takes place so slowly, it may not be recognized before conditions on the roadway become unsafe.

U.S. Patent No. 4,804,292 illustrates a run-off arrangement for deflecting and collecting water seepage from the seals and diverting it to the sides of the roadway beyond the underlying piers and bearings. However, it is necessary to incorporate the run-off system into the bridge structure during initial construction, or to make it part of a dramatic rehabilitation project.

Accordingly, existing roadways cannot benefit from such a run-off system without

reconstruction.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the invention is to overcome these difficulties.

5 According to a feature of the invention, these objects are obtained, in whole or in part, by horizontally securing run-off members against opposite faces at the gap of existing expansion joints either simultaneously or successively with a
10 horizontal thrusting device that a suitable device lowers and retracts from the gap. Each member is a deflector although one of the members also coacts with the other deflector as a collector. The two
deflectors overlap horizontally across the gap.

15 According to another feature of the invention, the run-off members are adhesively backed and secured by the adhesive to the faces of the gap.

 According to another feature of the invention, other means such as elding are used to
20 secure the run-off members to the gap faces.

 These and other features of the invention are pointed out in the claims. Other objects and advantages from the invention will become evident from the following detailed description when read in
25 light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view of an expansion joint with a resilient seal and a run-off arrangement embodying features of the invention.

5 Fig. 2 is a perspective view showing several overlapping adjacent collectors.

Fig. 3 is a sectional view of mounting means for mounting the run-off arrangement against the walls of an expansion joint from which the seal
10 has been removed and which shows a method and means embodying features of the invention.

Fig. 4 is a cross sectional view showing suitable means in the process of mounting a collector portion of the run-off arrangement onto
15 one wall of a gap formed in the expansion joint and embodying features of the invention.

Fig. 5 is a cross sectional view illustrating mounting of a deflection portion of the run-off arrangement embodying the invention.

20 Fig. 6 is a sectional view of a thruster using clips to hold the run-off members according to the invention.

Fig. 7 is a section view of a thruster

using magnets according to the invention.

Fig. 8 is a section of another run-off arrangement embodying the invention.

Fig. 9 is a section of another run-off
5 arrangement embodying the invention.

Figs. 10 and 11 illustrate details of the lowering device of Figs. 3 to 7 and the mandrel including the channel of Fig.4.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

10 In Fig. 1, two roadway or deck sections, DS1 and DS2 sit on bearings BE1 on a pier cap PC1 atop a structural pier SP1 and form an expansion joint, EJ1 between them. A compressed resilient seal RS1 seals the gap GP1 formed by the vertical
15 faces FA1 and FA2 of the decks DS1 and DS2 at the expansion joint EJ1. The seal RS1 sits on two seal seats SS1 and SS2 secured to the faces FA1 and FA2.

A liquid run-off arrangement RA1 includes a deflector DF1 secured against the face FA1 and a
20 collector CO2 secured against the face FA2 by respective adhesive mounts AD1 and AD2. Each adhesive mount AD1 and AD2 takes the form of a resin impregnated reinforced fiber mat, a thick jelly, or any adhesive that fills the interstices between the
25 deflector DF1 and the face FA1 on the one hand, and

the interstices between the collector C02 and the face FA2 on the other.

The deflector DF1 and collector C02 are each in the form of a stainless steel, reinforced plastic, or other non-corrosive sheet material bent as shown. The deflector DF1 and the collector C02 are, in fact, each deflectors. However, the collector C02 serves both the function of a deflector and a collector. The deflector DF1 and the collector C02 may also be termed run-off members.

According to another embodiment of the invention protected corrosive materials such as epoxy coated steel form the deflector DF1 and collector C02.

In operation, the seal RS1 prevents most liquid, made up largely of water and small amounts of other roadway liquid, from passing into the gap GP1 of the joint EJ1. However, the deflector DF1 passes any of the liquid at the left side of the seal into the collector C01. The collector C01 mounted on the face FA2 receives the remaining liquid not deflected by the deflector DF1. The collector C02 is tilted in the horizontal direction (into the page in Fig. 1) to pass the collected liquid beyond the structural pier SP1 and the pier cap PC1.

The run-off arrangement CA1 may be

composed of a single deflector DF1 and a single collector CO2 extending across an entire roadway or may constitute horizontally overlapping deflectors and collectors of which overlapping collectors CO2 are shown in Fig. 2. The collector CO2 are pitched downwardly toward the edges of the deck and identified as CO21 and CO22. To prevent leakage, extra thicknesses of adhesive AD2 are applied near the overlap portion of the section CO21.

Fig. 3 illustrates an apparatus and method for securing the run-off assembly CA1 to the faces FA1 and FA2 forming the gap GP1 of the expansion joint EJ1. The process starts by removing the seal RS1 and cleaning the surfaces of the faces FA1 and FA2 with rotating brushes.

In Fig. 3 the seal RS1 has been removed and the faces cleaned. A lowering device LD1 lowers an I beam (or structural mandrel) IB1 with a shaft SH1 into the gap GP1 in the expansion joint EJ1. Support sections SU1 and SU2 magnetically or mechanically hold the deflector DF1 and collector CO2 against the I beam. The adhesive mounts AD1 and AD2 appear at the backs of the deflector DF1 and collector CO2 in an uncured condition. A horizontal pressure control HP1 triggers pressure thrusters or actuators PT1 and PT2 mounted on respective sides of the I beam IB1. The thrusters or actuators PT1 and PT2 may take the form of bellows expansible horizontally under pressure from compressed air in the control HP1, compressed expansion springs which

can be magnetically released by the horizontal pressure control HP1, electromagnetic repulsion devices, or other means for driving the adhesively backed portions of the deflector DF1 and the collector CO2 against the faces FA1 and FA2 so that the deflector DF1 and the collector CO2 adhere to the faces FA1 and FA2 as shown in Fig. 1.

In operation of Fig. 3, the lowering device LD1 lowers the I beam IB1 with the loaded pressure triggers PT1 and PT2 behind the deflector DF1 and collector CO2 as shown in Fig. 3 into a space below the seal seat SS1 and SS2. The horizontal pressure control HP1 then actuates the hydraulic, fluid, spring, electromagnetic repulsion, or other force devices to force the adhesive carrying deflector and collector EF1 and CO2 against the faces FA1 and FA2 into the positions shown in Fig. 1 .

When the adhesive backing AD1 cures enough to hold, the horizontal pressure control HP1 releases the horizontal pressure by causing the thrusters or actuators PT1 and PT2 to turn off the hydraulic or fluid pressure, by retracting the springs, by turning off the electromagnetic thrusters or actuators, or by other means. Thereafter, the lowering device LD1 withdraws the I-beam IB1.

Figs. 4 and 5 illustrate other means for mounting the deflector and collector DF1 and CO2,

particularly into gaps GP1 whose spaces are too small to accept both the deflector DF1 and the collector CO2 at the same time. Here, the lowering device LD1 lowers a channel CH1 that carries the collector CO2 with the adhesive backing AD2 into the gap GP1 below the seal seats SS1 and SS2. The horizontal pressure control HP1 actuates the pressure thruster PT1 which forces the collector CO2 against the face FA2 into the position shown in Fig. 1 and 5. As In Fig. 1, the control HP1 energizes the pressure thruster PT1 by initiating hydraulic or fluid (pneumatic) pressure, starting electromagnetic force; releasing springs, or the like.

When the adhesive backing AD1 cures enough at least partially, enough to hold, the horizontal pressure control HP1 releases the horizontal pressure by causing the thruster or actuator PT1 to turn off the hydraulic or fluid pressure, by retracting the springs, by turning off the electromagnetic thrusters or actuators, or by other means. Thereafter, the lowering device LD1 withdraws the channel CH1.

Above the deck sections, DS1 and DS2, the lowering device LD1 then reverses the horizontal direction of the channel CH1 and the horizontal pressure control HP1 sets the horizontal pressure thruster PT1. The lowering device LD1 then lowers the channel CH1 with the deflector DF1 into the gap GP1 at a space opposite the collector CO2 and the pressure control HP1 triggers the pressure thruster

PT1 to drive the deflector DF1 and the adhesive AD1 against the face FA1. When the adhesive AD1 has cured, the control HP1 releases the thruster PT1 by eliminating the hydraulic or fluid pressure,
5 retracting the springs, eliminating the electromagnetic repulsion, or otherwise eliminating the horizontal thrust and withdraws the channel. This sets the run-off arrangement as shown in Fig. 1.

10 As stated, in Figs. 4 and 5, the horizontal control HP1 keeps causing the pressure thrusters PT1 and PT2 to hold the deflector DF1 and the collector CO2 against the faces FA1 and FA2 until the adhesives AD1 and AD2 have at least
15 partially cured enough to hold the deflector and collector against the faces. Thereafter, the horizontal pressure control deactivates the pressure thrusters' hydraulic or fluid (pneumatic) pressure, retracts the springs, deactivates the
20 electromagnetic repulsion, or otherwise withdraws the horizontal pressure so that the lowering device can withdraw the I-beam IB1 from the gap GP1. Thereafter, the seal RS1 is force fitted above the seal seats SS1 and SS2 as shown in Fig. 1.

25 The run-off arrangement RA1 avoids the leakage which the seal RS1 may permit because it hangs off separate walls and is not subject to the same forces as the seal. The deflector DF1 and the collector CO2 may move independently of each other.
30 They do not receive forces which might distort and

damage other structures between the faces FA1 and FA2.

According to an embodiment of the invention, caulking between the top rims of the deflector DF1 and the collector CO2 and the respective faces FA1 and FA2 furnish further protection against leaks. According to still another embodiment mechanical means such as bolts or welds, with or without adhesive materials AD1 and AD2, but with caulking, hold the deflector DF1 and collector CO2 against faces FA1 and FA2.

The gap GP1 between the faces FA1 and FA2 may be as small as one-half inch and as wide as 3 or more inches. The lengths and angles of the bends in the deflectors FD1 and collectors CO2 vary accordingly.

Joints such as the joint EJ1 extend not only across the longitudinal direction of an elevated roadway but may also extend longitudinally. For that purpose the collectors CO1 include spouts to direct the collected liquid away from bearings, piers, caps, and other structural members.

The cleaning device for cleaning the faces FA1 and FA2 takes the form of a carriage frame on wheels for a motor and a shaft. The motor turns the shaft and a series of different brushes on the end of the shaft clean the primary dirt, rust, and old glue that might have been used to keep seals in the

RS1.

Expansion joints such as joints, ED1 protect not only against thermal expansion but other movements of roadway sections or deck section DS1 and DS2. Also the lowering device LD1 may be of the hydraulic, pneumatic, mechanical, manual, or other type.

For mechanically holding the deflector DF1 and the collector CO2 on the I beam IB1 and the channel CH1, biasing clips CL1 on the support SU1 and SU2 grasp the members DF1 and CO2 and secure them in the position shown in Fig. 6. For magnetic attachment, permanent magnets PM1 and PM2 attract magnetic sections MS1 and MS2 to hold the members DF1 and CO2 in position as shown in Fig. 7. Figs. 6 and 7 apply equally to channels as well as I beams.

The adhesive materials AD1 and AD2 are thick enough to fill interstices in both the faces FA1, or FA2 and whatever breaks exist in the member DF1 and CO2.

The process for applying the run-off arrangement RA1 avoids removing the seal seats SS1 and SS2. These seats may be removed and replaced by means other than those connected with the present invention. Normally however, the seal seats SS1 and SS2 are firmly mounted by welding or otherwise in the faces FA1 and FA2.

According to another embodiment of the invention, the systems of Fig. 1,2,7 apply to two deflectors and a single collector as shown in Fig. 8. The manner of application is the same in Figs. 1 to 7. However, it involves applying first the collector, and then the lowermost deflector DF2 and lastly the upper deflector DF1. This embodiment embraces all of the other embodiments for application and positioning.

The expansion joints of Figs. 1 and 3 to 8 may include metal armor AR1 along the faces of the faces FA1 and FA2 as shown in Fig. 9. According to embodiments of the invention, the pressure thrusters PT1 and PT2 contain a welding arrangement WE1 for welding the deflector DE1 and the collector CO1 onto the armor AR1.

Figs. 10 and 11 illustrate details of the lowering device LD1 of Figs. 3 to 7 and the mandrel including the channel CH1 of Figs. 4 and 5.

According to another embodiment of the invention, the deflector DF1 and collector CO2 abut against each other. According to yet another embodiment, the deflector DE1 and collector CO2 are spliced together.

While embodiments of the invention have been described in detail, it will be evident to those skilled in the art that the invention may be embodied otherwise without departing from its spirit

and scope.

e

v

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What is claimed is:

1. A method which comprises:
 - cleaning a gap in an expansion joint of a roadway;
 - 5 securing a run-off arrangement on opposing vertical faces that form a gap in an expansion joint of a roadway;
 - said securing step including:
 - 10 a. removably mounting a run-off member on a horizontal thrusting device, with the member having an section facing away from the thrusting device;
 - b. lowering the thrusting device and the member into the gap between the vertical faces;
 - 15 c. pressing the section of the member against one of the vertical faces by actuating the horizontal thrusting device;
 - d. bonding the section against the vertical face;
 - 20 e. deactuating the thrusting device; and
 - f. withdrawing the thrusting device from the gap; and

said securing step further including applying a second member horizontally overlapping the first member against the other of the faces within the gap.

5 2. A method as in claim 1, wherein:

 said applying step further includes:

 a. removably mounting a second run-off member on the horizontal thrusting device before lowering the thrusting device, the second member
10 having a section facing away from the thrusting device; and

 b. pressing the section of the second run-off member on the horizontal device against the other of the vertical faces
15 simultaneously with the first member.

 3. A method as in claim 1, wherein the step of applying includes:

 a. removably mounting a second run-off member on the horizontal thrusting device after
20 withdrawing the thrusting device from the gap, the second member having an section facing away from the thrusting device;

b. lowering the thrusting device and the member into the gap between the vertical faces so that the section faces the other of the faces;

5 c. pressing the section of the member against the other of said faces by again actuating the horizontal thrusting device;

d. again deactuating the thrusting device; and

10 e. withdrawing the thrusting device from the gap.

4. A method as in claim 1, further comprising the steps of:

removing a resilient seal from the gap before lowering the thrusting device into the gap
15 below the position of the seal; and replacing a resilient seal into the gap after withdrawing the device.

5. An expansion joint comprising:

a seal compressed between vertical faces
at a gap;

a water run-off arrangement bonded to
5 the faces at a gap;

said run-off arrangement including two
elongated overlapping portions each secured to one
face extending along the gap and projecting toward
each other so to overlap across the gap.

6. An apparatus for retrofitting a water run-off arrangement to the vertical faces at a gap of an expansion joint, comprising:

5 elongated thrusting means having vertical sidewalls;

holding means in said elongated thrusting means for holding elongated member of a run-off arrangement along one of the vertical sidewalls;

10 remotely actuatable horizontal pressure applying means in said elongated thrusting means for applying force on the member in a direction away from said thrusting means;

15 lowering means for lowering said thrusting means into the gap and withdrawing said thrusting means from the gap;

control means for actuating the pressure applying means and doing said pressure applying means to force the member against one of the faces.

7. An apparatus as in Claim 6; where

said thrusting means includes second
holding means for holding a second elongated member
of the run-off arrangement along the other of the
5 vertical sidewalls;

said thrusting means includes second
pressure applying means for applying force on the
second member in a second direction opposite to that
of the first direction;

10 said control means including means for
actuating said second applying means and causing
said second pressure applying means to force the
second member against the other face.

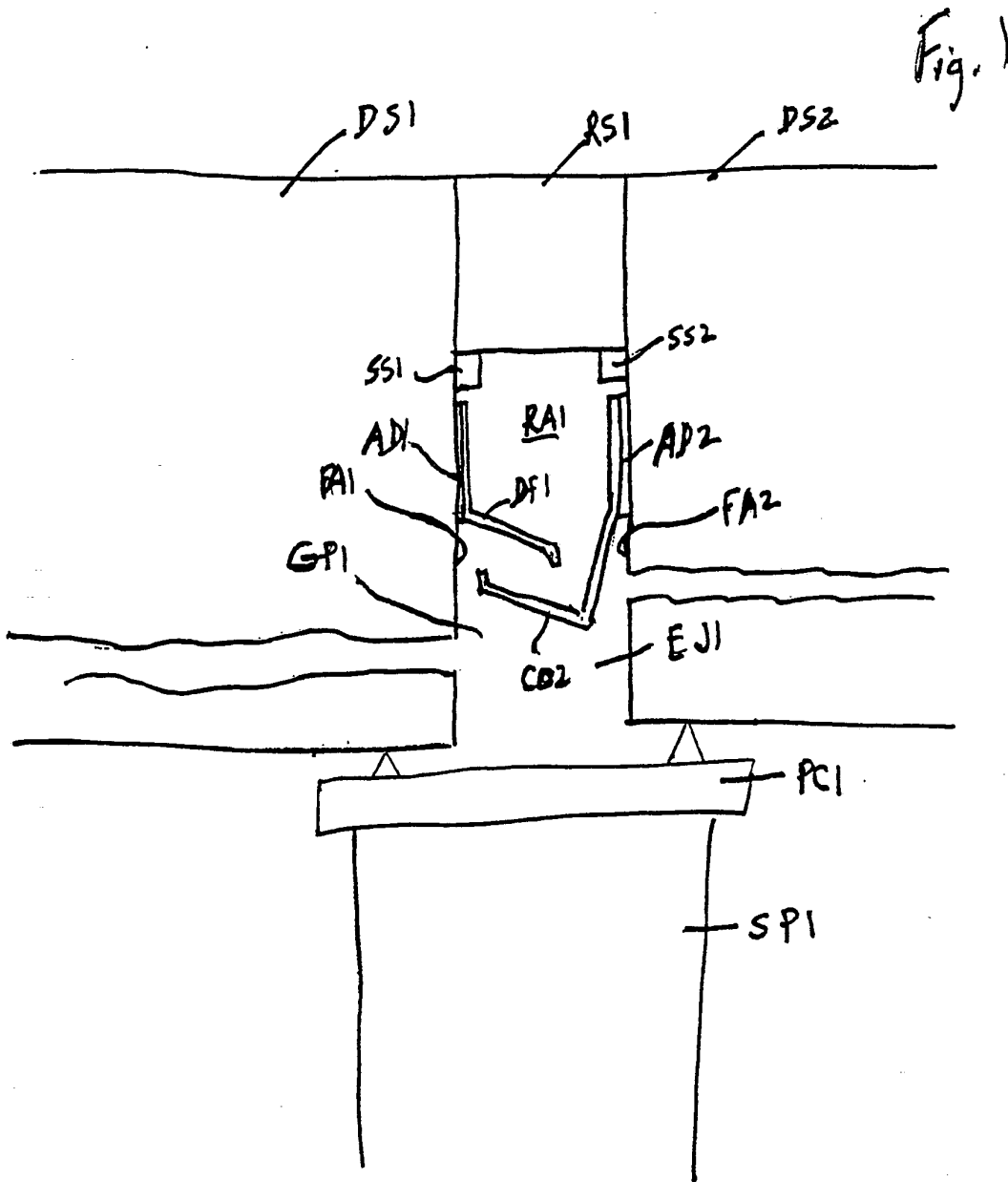


Fig. 1

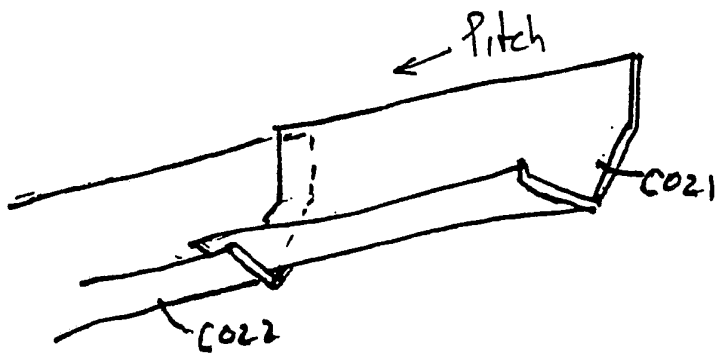


Fig. 2

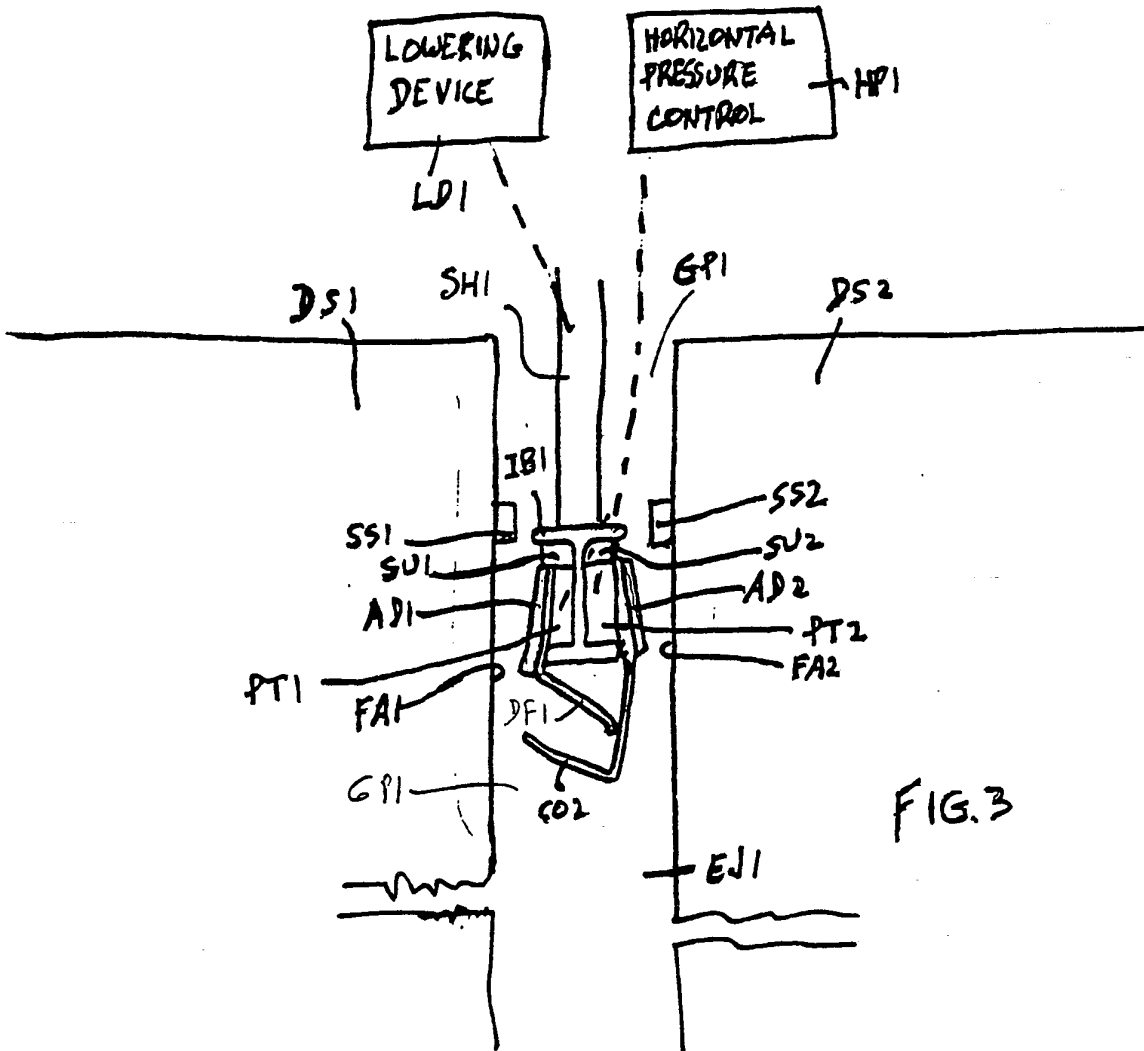


FIG. 3

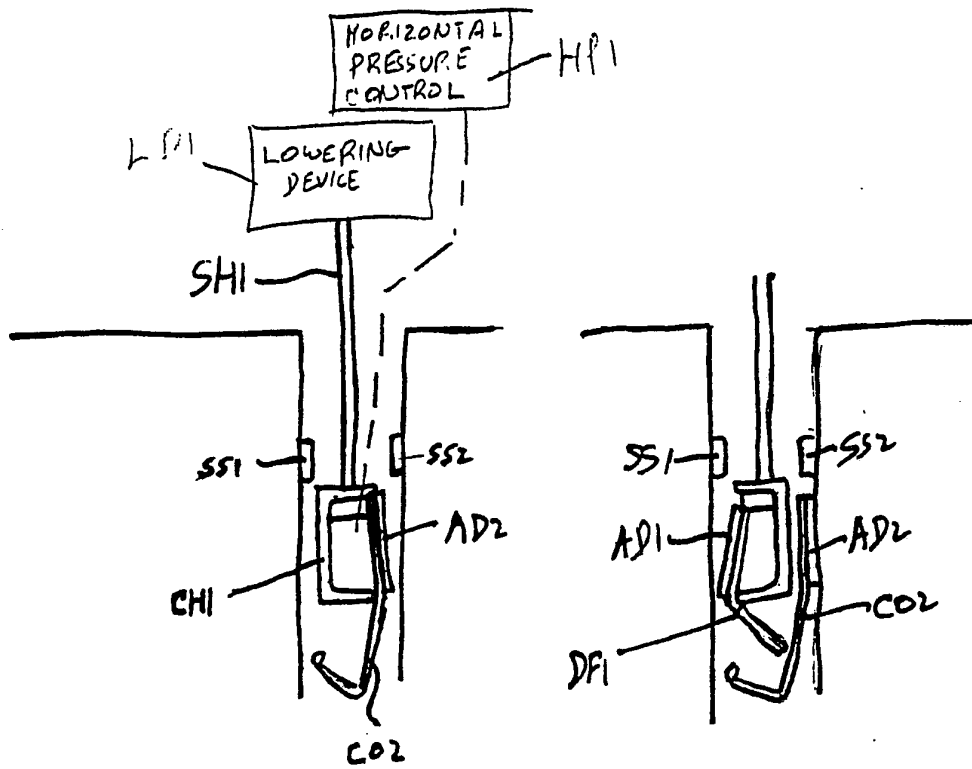


Fig. 4

Fig 5

Fig 6

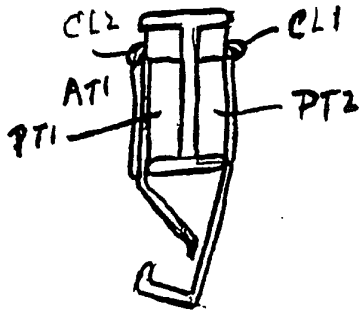


Fig 7

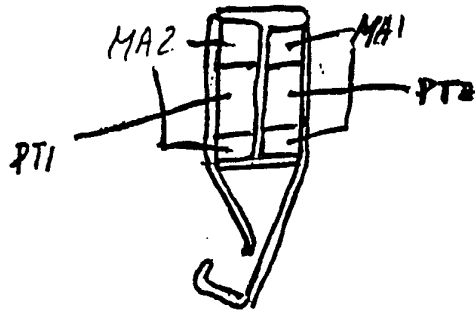


Fig. 9

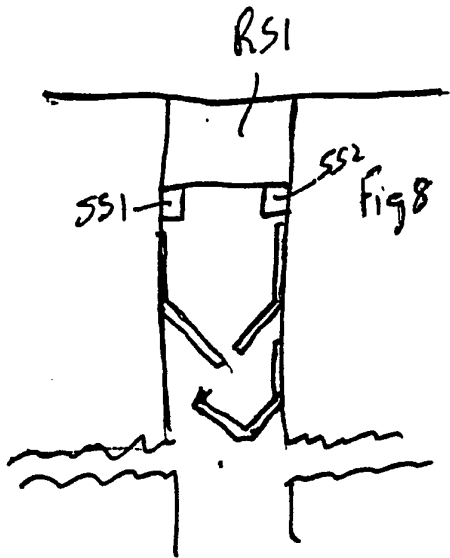


Fig. 8

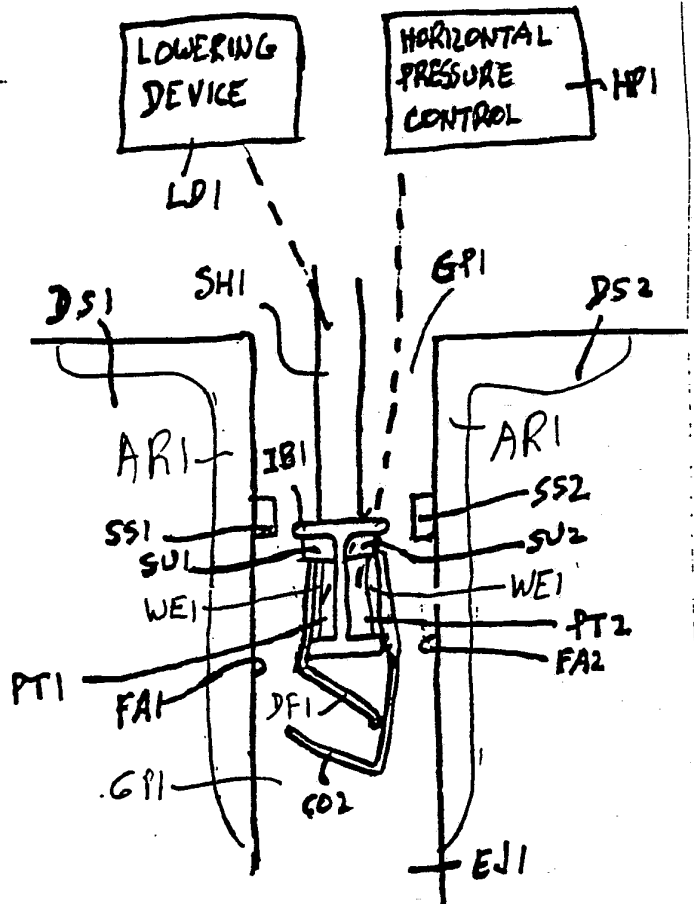
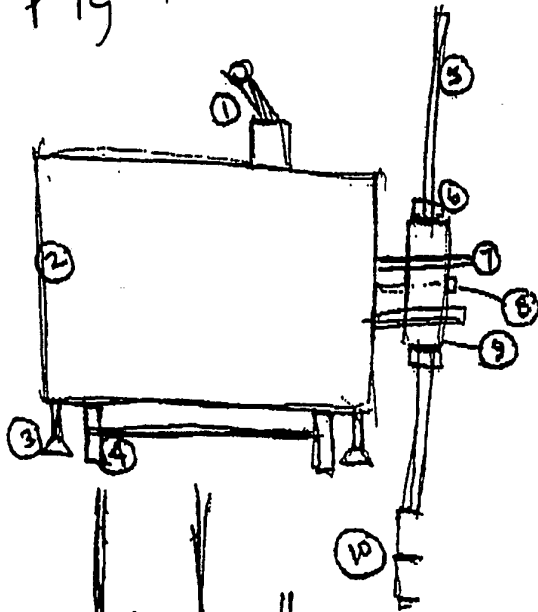
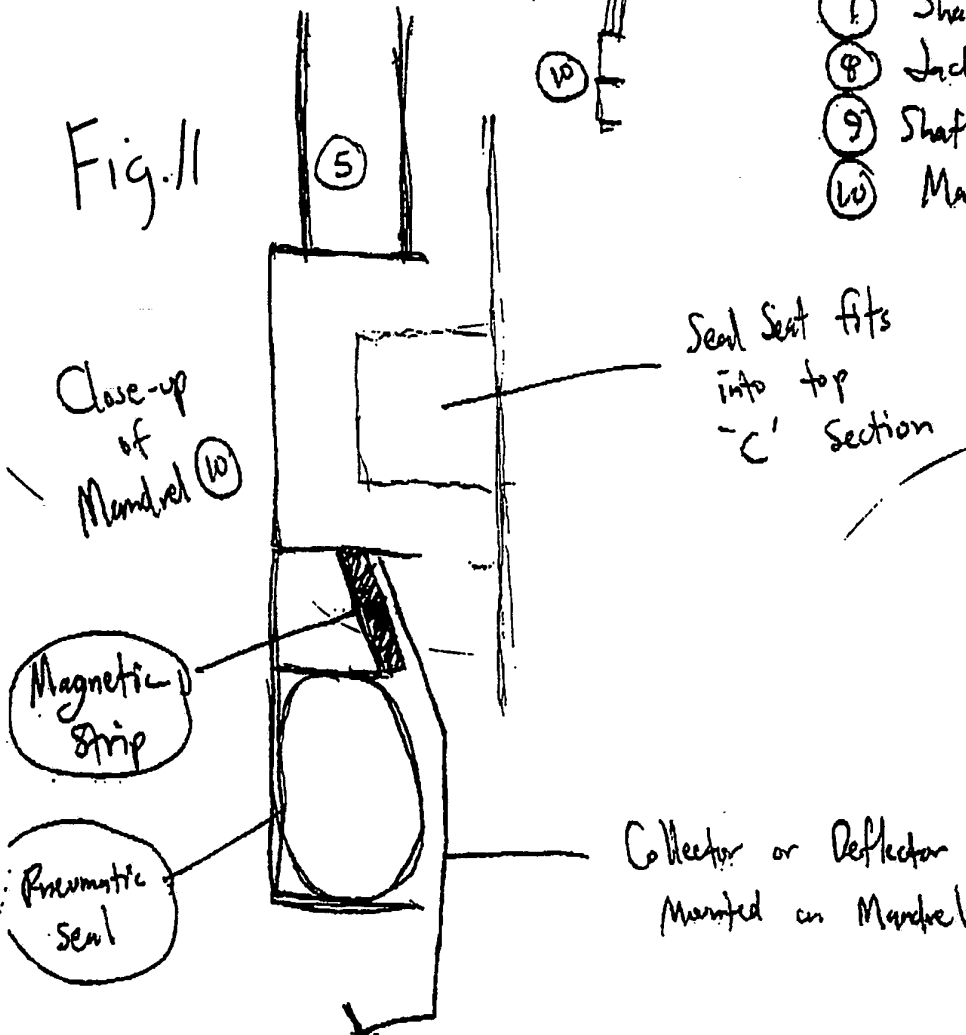


Fig 10



- ① Pneumatic Valve
- ② Frame 16" x 12" x 60" Long
- ③ Leveling Pads
- ④ Wheels
- ⑤ Shafts for Vertical Lift and Drop
- ⑥ Set Collars on Shaft ⑤
- ⑦ Shafts for Horizontal Movement
- ⑧ Jacking Screw to set horizontal
- ⑨ Shaft Mounting Block
- ⑩ Mandrel

Fig. 11



INTERNATIONAL SEARCH REPORT

PCT/US92/09357

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :E01C 11/02

US CL :404/49,68

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 404/49,68 404/47,48,54,87

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 580,701 (McMenamin) 13 April 1897 See entire document.	1-7
A	US,A, 4,699,540 (Gibbon et al.) 13 October 1987 See entire document.	1-7
A	GB,A, 1,175,745 (Neymarc) 23 December 1969 See entire document.	1-7

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be part of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search

11 JANUARY 1993

Date of mailing of the international search report

19 JAN 1993

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