United States Patent

[11] 3,612,277

[72] Inventors **Merle H. Van Stavern; Wylie T. Jones; Howard F. Cossey; Wendall J. Clark, all of Richmond, Va.**

[21] Appl. No. **46,057**
[22] Filed **June 15, 1970**
[45] Patented **Oct. 12, 1971**

[73] Assignee **Texaco Inc. New York, N.Y.**

[54] **METHOD OF RECOVERING OIL FROM AN OIL SLICK**
2 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **210/83,** 210/179, 210/242, 210/523
[51] **Int. Cl.** **B01d 17/02**
[50] **Field of Search** ..... 210/77, 402, DIG. 21, 83, 242, 179, 523, 386

[56] **References Cited**

UNITED STATES PATENTS

1,379,176	5/1921	Foster	210/402 X
1,860,819	5/1932	Schamberger	210/77 X
3,426,902	2/1969	Kilpert et al.	210/402 X
2,278,526	4/1942	Rich	210/386

Primary Examiner—Michael Rogers
Attorneys—Thomas H. Whaley, Carl G. Reis and L. H. Phelps, Jr.

ABSTRACT: A rotatable drum type of oil skimmer which is continually rotated to pick up a film of oil and water on the surface of the drum, having a supplemental or transfer drum located substantially above the oil slick and well out of contact therewith, so as to come into contact with film on the pickup drum and receive a portion of the film, product oil being recovered from both drums.

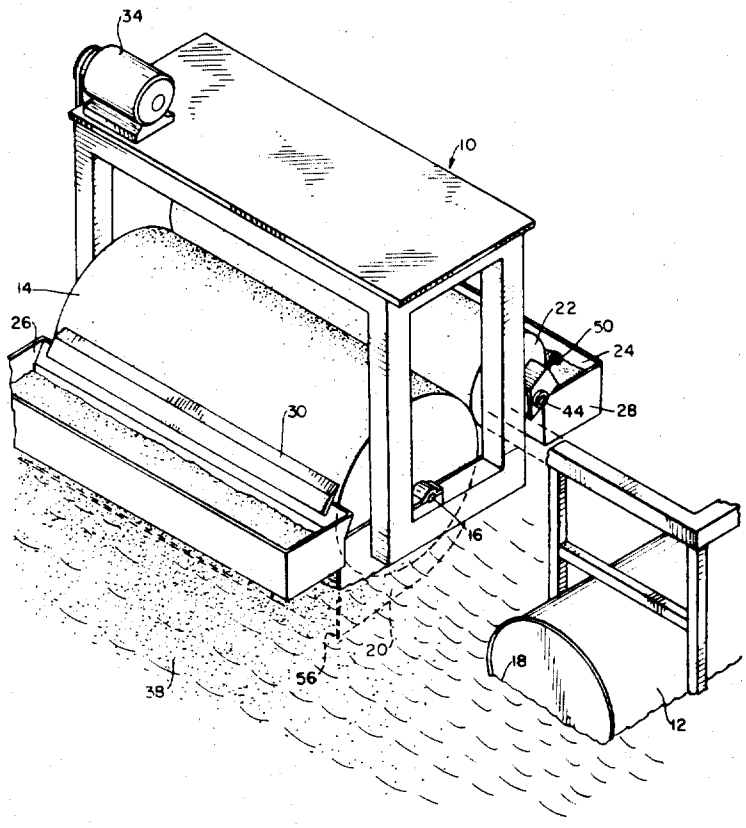


FIG. 1

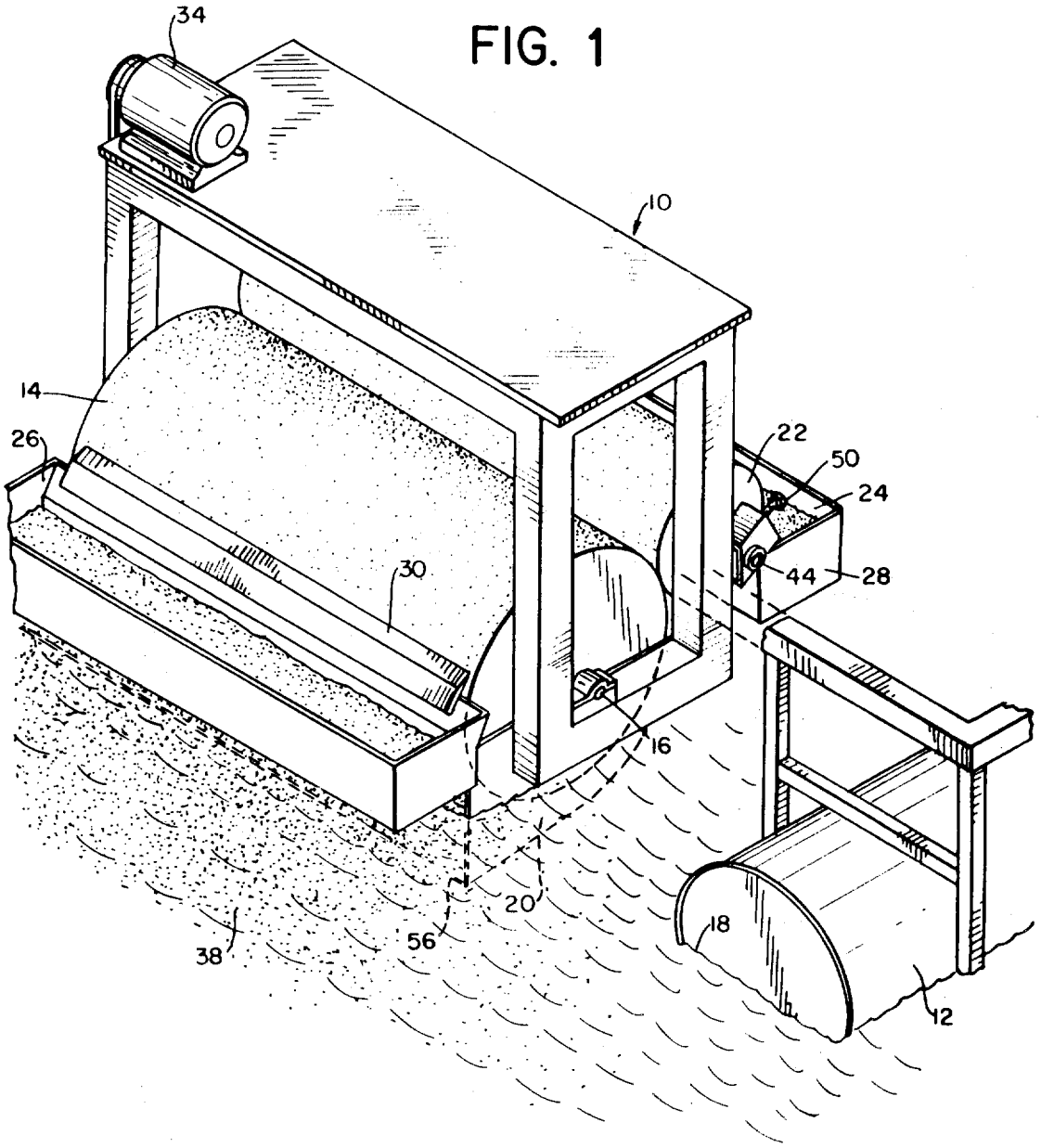


FIG. 2

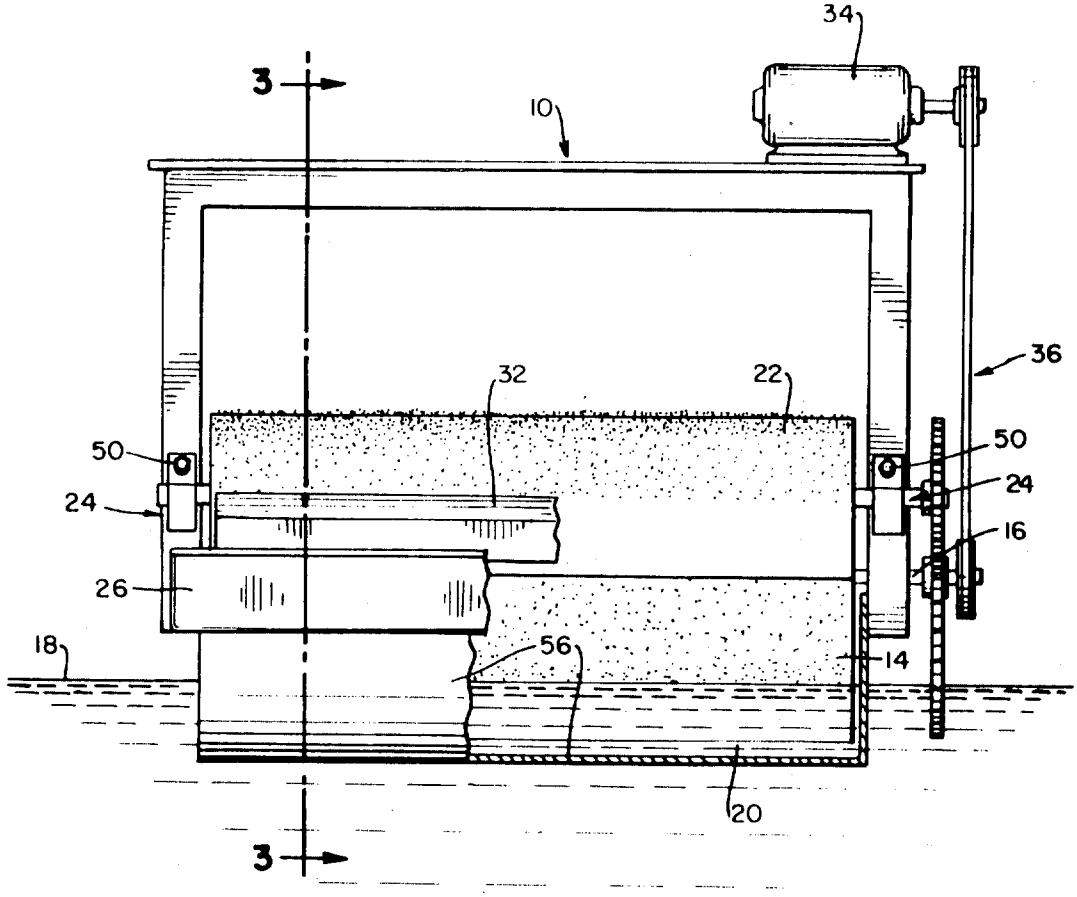


FIG. 3

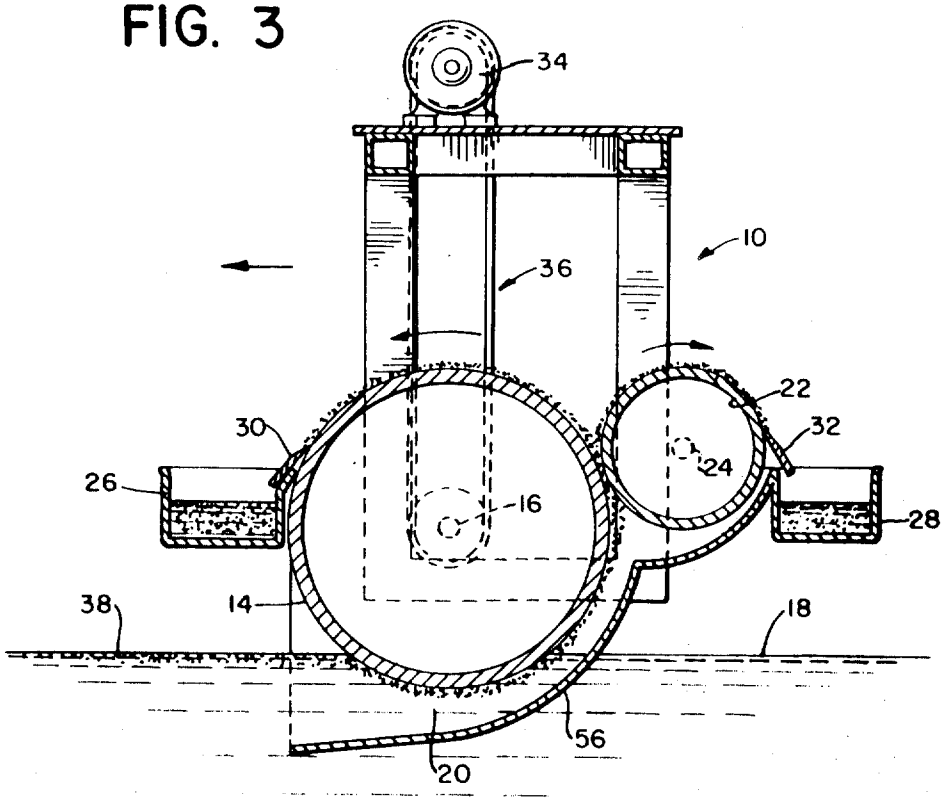
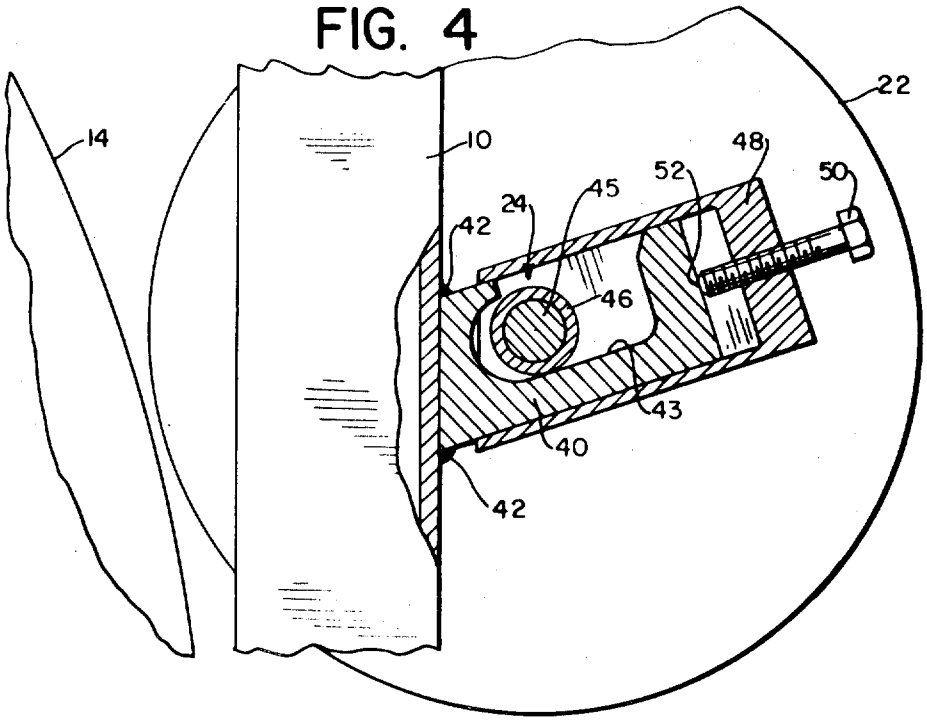

34
10
36
22
30
32
24
26
16
28
38
14
18
56
20

FIG. 4


22
14
10
48
52
50
45
24
42
46
43
40
42

METHOD OF RECOVERING OIL FROM AN OIL SLICK

The present invention relates to oil skimming, namely the cleanup and recovery of an oil slick from a water surface by means of a rotating roll dipping into the surface of the water.

Heretofore there have been proposed a great number of various devices for arrangement on floating vessels or for fixed disposition over a water channel involving rolls which may be cylindrical or of other annular modifications of quite widely varying shape, the lower surfaces of which dip into the oil slick and are rotated in such a direction as to pick up a layer of oil which is then scraped or otherwise removed from the surface of the roll, as shown, for example, in U.S. Pat. No. 3,245,539. In this way it has been found possible to recover an oil layer floating on a water surface.

The layer of oil picked up by the roller partially submerged in water is usually accompanied by a considerable amount of water. While this may not be disadvantageous where additional separating means is provided, nevertheless the accompanying water correspondingly limits the amount of recovered oil which can be handled by the equipment and can seriously limit the usefulness of this equipment, especially where operations are being conducted from a vessel at sea. Moreover, where as is customary, recovery is urgent and the rolls are accordingly operating at relatively high rates of rotation, water contamination becomes more and more serious.

The present invention provides a roller skimmer adapted for improved oil recovery and water separation wherein the oil layer is picked up on the main or pickup roll which contacts the oil slick and coacts with a supplemental or transfer roll arranged parallel to the main or pickup roll and in juxtaposition thereto, preferably at a critical spacing therefrom, such that the transfer roll makes contact with the oil layer on the pickup roll.

The transfer roll, since it is located out of contact with the oil slick, receives a layer of oil and is coated thereby from the pickup roll. Accordingly, the provision of scrapers, doctor blades or squeegees on the respective rolls not only results in recovery of oil from both rolls, but a somewhat reduced overall recovery of water.

Of surprising significance, therefore, is the fact that the action of the two rolls appears to effect a somewhat increased oil recovery rate with good water separation, particularly where relatively thick oil layers are involved.

Accordingly, the two rolls, namely both the pickup roll and the supplemental or transfer roll are arranged with their axes in parallelism, and with adjacent surfaces at an appropriate spacing, as will hereinafter more fully appear, to effect maximum recovery of oil with somewhat less accompanying water.

Also, the transfer roll is located above the surface of the water and of the floating oil slick or spill so that it normally acquires its oil layer exclusively by contact with the oil layer or film on the pickup roll.

This is of considerable importance since it avoids excessive water pickup as is the tendency in the case of the dual-roll assembly shown in U.S. Patent No. 1,860,819 issued to J. Schamberger on May 31, 1932. Therein two oppositely rotating pickup rolls dip into the water and thus aggravate the problem.

The rolls may be rotated in opposite directions and at such rotational speeds that the surface velocities are preferably essentially identical and in the same tangential directions. Rotation in opposite directions or at different rates enables the transfer roll to "wipe off" somewhat larger recoveries of oil.

The pickup roll is preferably arranged horizontally over the oil slick and so rotated as to move downwardly into the slick and therefore preferentially make initial contact with the oil layer as it moves downwardly into the marine surface.

In order to more fully illustrate the present invention reference is made to the specific embodiment thereof, illustrated by the figures of the accompanying drawing, wherein

FIG. 1 is a perspective view of a portion of a pickup float or vessel constructed in accordance with the present invention,

FIG. 2 is an elevational detail taken from the rear of Fig. 1 with portions of the vessel, the recovery trough and baffle broken away to show the underlying structure,

FIG. 3 is a sectional view taken on the line 3—3 of Fig. 2 and

FIG. 4 is a detailed fragmentary view of an adjustable journal for the transfer roller.

Referring now to the figures in the drawing, 10 represents the frame of the device which is carried by a pair of floats 12 which may take the form of any suitable marine vessel. Where it is desired to arrange the oil pickup device over a fixed channel, the frame can be mounted on suitable supports over the channel.

The pickup roller which, in the present embodiment comprises cylinder 14, is journaled as at 16 in frame 10. Roll 14 is so arranged that its extremity dips into the water surface 18 as at 20.

A supplemental or transfer roller comprises cylinder 22, likewise journaled at 24 on the frame 10 and located in a position above and out of contact with the oil slick 38.

Pickup troughs 26 and 28 are arranged respectively adjacent the pickup roll 14 and transfer roll 22 to receive the film removed by scrapers or doctor blades 30 and 32, which bear, in turn, against the respective rollers. The rollers may be rotated in opposite rotational directions by drive motor 34 and suitable belt-and-gear drive 36, as shown more clearly in Fig. 2 so that the surfaces (in the instant embodiment) move in juxtaposition at approximately the same speed and in the same direction.

As indicated more clearly in the more or less diagrammatic representation of Fig. 3, the roller 14, rotates in a counterclockwise direction. This is a particularly good arrangement where the direction of movement of the vessel is toward the left as viewed in the figure, or where, conversely, the flow of oil spill is from the left. In this arrangement the rotating surface which has just left the doctor blade, first contacts oil layer 38 and carries the adherent oil downwardly and (if the oil layer is a thin one) thru the water surface. Thereafter it emerges and proceeds up to the bight between rolls 14 and 22, at which point the surface of roll 22, rotating in the opposite angular direction, contacts the oil layer as shown, picking up a portion thereof before it can flow off and tending to reject the contained water downwardly as indicated in Fig. 3.

Means are provided as shown more clearly in Figs. 3 and 4 for adjusting the spacing between the parallel rollers 22 and 14, comprising a projecting journal support 40 welded to the frame 10 as at 42 and provided with a central recess 43 to accommodate shaft 44 and journal 46 of roller 22.

The shaft 44 of roller 22 and the journal 46 ride in an adjustable box or sleeve 48 which is supported by the journal support 40. Adjustment of the box 48 inwardly or outwardly along support 40 causes roller 22 to move transversely toward or way from the pickup roller 14 to adjust the spacing therebetween.

This adjustment is accomplished by machine bolt 50 which is threaded through box 48 and contacts the journal support 40 as at 52.

In operation therefore the roller dips into the oil slick 38, as indicated in Fig. 3, carrying a layer of oil up into the bight between rollers 14 and 22 where a portion is transferred to roller 22 and water separation takes place. The two rollers accordingly continue to rotate, coated with more or less equivalent layers of oil, which are then cleared by doctor blades 30 and 32.

By spacing the rolls appropriately it has been discovered that water separation and improved oil recovery is effected. Since the preferred range of gap settings between the transfer roll and the pickup roll varies with the oil viscosity and is most effective with the more viscous oils, its proper selection is most easily accomplished by a trial-and-error test by the operator.

Because an important objective of the present invention is to recover and separate the oil at reasonable rates it is desirable to rotate the pickup roll at as great a speed as is possible while still maintaining a good, continuous film of oil thereon. For this reason it is desirable also to maintain the spacing between the two rolls at or about the maximum at which proper recovery and separation takes place.

The following experimental results illustrate the type of improvement observed in connection with the present invention.

The experiment here was conducted with a pickup and a transfer roll arranged with respect to one another essentially as shown in the figures of the drawing but with laboratory scale equipment, using pickup and transfer rolls both of which were 12 inches in diameter and 6 inches wide, namely 6 inches in an axial direction. The transfer roll was located substantially above the water level in approximately the relationship to the pickup roll as shown in the figures.

The oil used in the experiments was solvent neutral oil 40.

	Specification
API Gravity	26.5–29.0
Viscosity, SSU at 100° F.	800–890
Viscosity, SSU at 210° F.	
Flash, COC, ° F.	480 Min.
Pour, ° F.	15 Max.

The oil layer on the surface of the water was maintained at 0.5 inch. Water temperature 48° F.

The results were as follows:

	Pick-up roll, r.p.m.	Pick up roll BPD			Transfer roll BPD			Total BPD			Percent	
		Oil	Water	Total	Oil	Water	Total	Oil	Water	Total	Oil	Water
No transfer roll	60	74.1	47.3	121.4				74.1	47.3	121.4	61.0	39.0
Transfer roll forward at 0.05 in. gap	60	107.0	37.7	144.7	11.0	11.0	22.0	118.0	48.7	166.7	70.8	29.2
Transfer roll reverse at 0.05 in. gap	60	90.6	34.3	124.9	12.4	5.5	17.9	113.0	39.8	152.8	74.0	26.0
Transfer roll reverse at 0.03 in. gap	60	68.6	16.5	85.1	25.4	3.4	28.8	94.0	19.9	113.9	82.5	17.5
Transfer roll reverse at 0.07 in. gap	60	94.0	27.4	121.4	8.9	3.4	12.3	102.9	30.8	133.7	77.0	23.0

In the foregoing data the figures for no-transfer roll were obtained by retracting the transfer roll from the pickup roll to the point where it made no contact whatsoever with the oil layer. The succeeding data shows comparable results with the transfer roll arranged at various gap spacings indicated and in contact with the liquid being raised by the pickup roll. The second row shows operation with the transfer roll spaced 0.5 inch from the pickup roll.

It is to be noted that there is a significant increase in the quantity of oil recovered as expressed in barrels per day, from 74.1 to 118.0. At the same time the percent of water in the product is reduced approximately 25 percent.

The third horizontal row shows data for operation under the same conditions but with the transfer roll rotating in the reverse direction, namely in the same angular direction as the pickup roll but in an opposite direction at the point of closest peripheral approach. On this basis in the immediately preceding row the transfer roll is operating at the same rotational speed but in the opposite rotational direction as the pickup roll so that the two surfaces are moving at the identical speed and direction at the point of closest approach. Note that with reverse rotation the oil recovery is down slightly but at a somewhat improved water content.

It has been further discovered that substantial cooling or chilling of the rollers below ambient temperatures particularly favors the foregoing improvement. This presumably follows from the fact, above intimated, that the present invention is favored by increased oil viscosity. Therefore any significant lowering of the oil temperature below ambient will ordinarily tend to increase viscosity and favor realization of the oil separation.

The details of many appropriate chilling means or mechanisms will be apparent to any skilled mechanic in light of the present disclosure and are therefore not shown herein.

It will suffice to say that chilling may be effected by simply passing a flow of coolant through the drums or by continuously introducing a stream of refrigerant such as liquid nitrogen into the drum or roller, via one axle shaft and appropriately withdrawing the nitrogen gas through the other.

We claim:

1. The method of recovering oil from an oil slick on a marine surface wherein the lower surface of a rotating roller is continuously rotated into contact with an oil slick, removing therefrom an adhering layer of oil with accompanying water, the improvement which comprises

passing said surface with its adhering layer of oil adjacent the surface of a parallel transfer roller which is located substantially above and out of contact with the oil spill,

the surfaces of said two rollers being spaced a distance such that there is a substantial gap between the adjacent surfaces of the two rollers, the surface of the transfer roller however contacting said adhering layer of oil on the pickup roller to receive a layer of oil therefrom and

recovering the oil layer from both of said rollers.

2. The method of recovering oil from an oil slick floating on a marine surface as called for in claim 1 wherein cooling means is provided for continuously introducing a refrigerant into the interior of one or more of the drums.