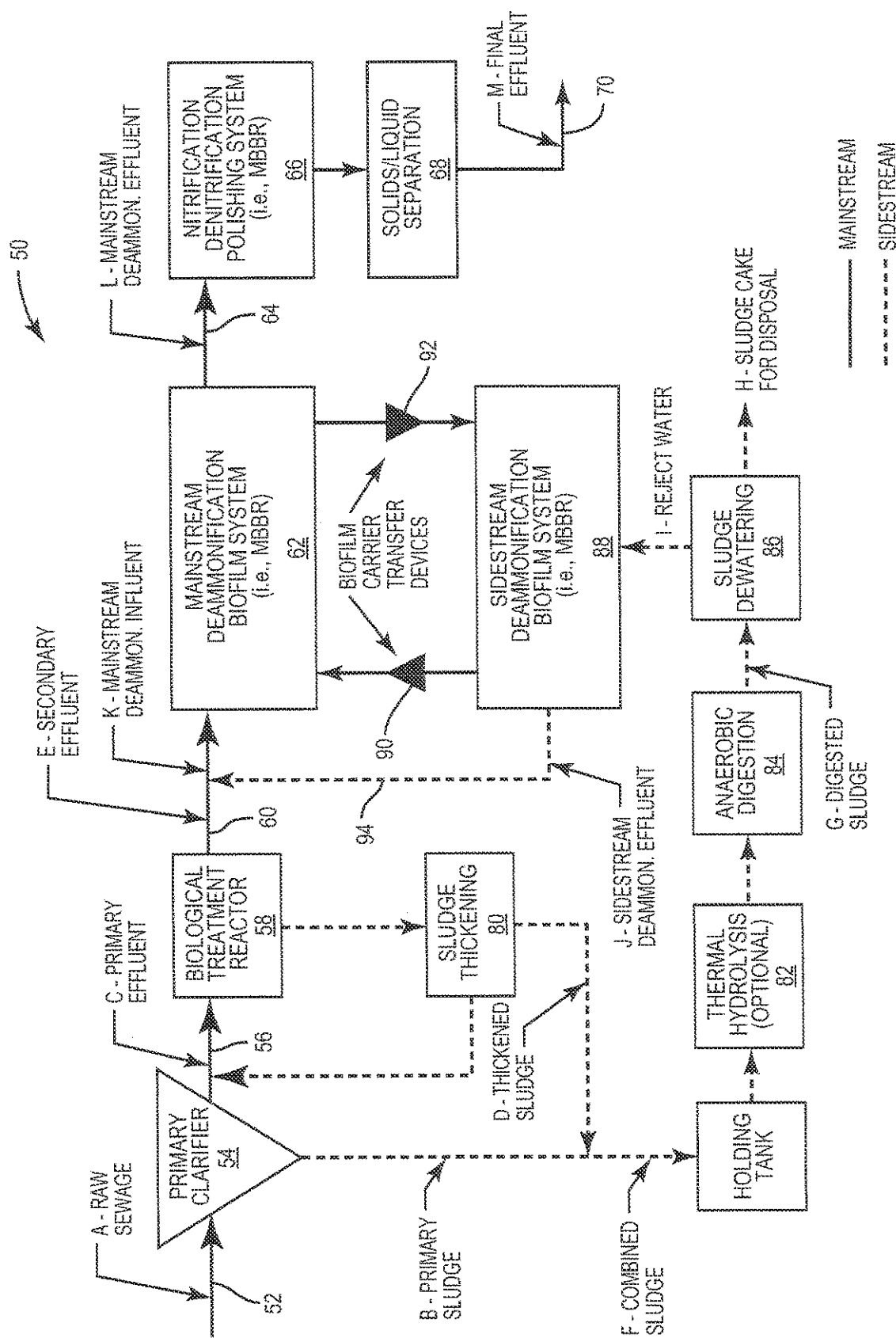




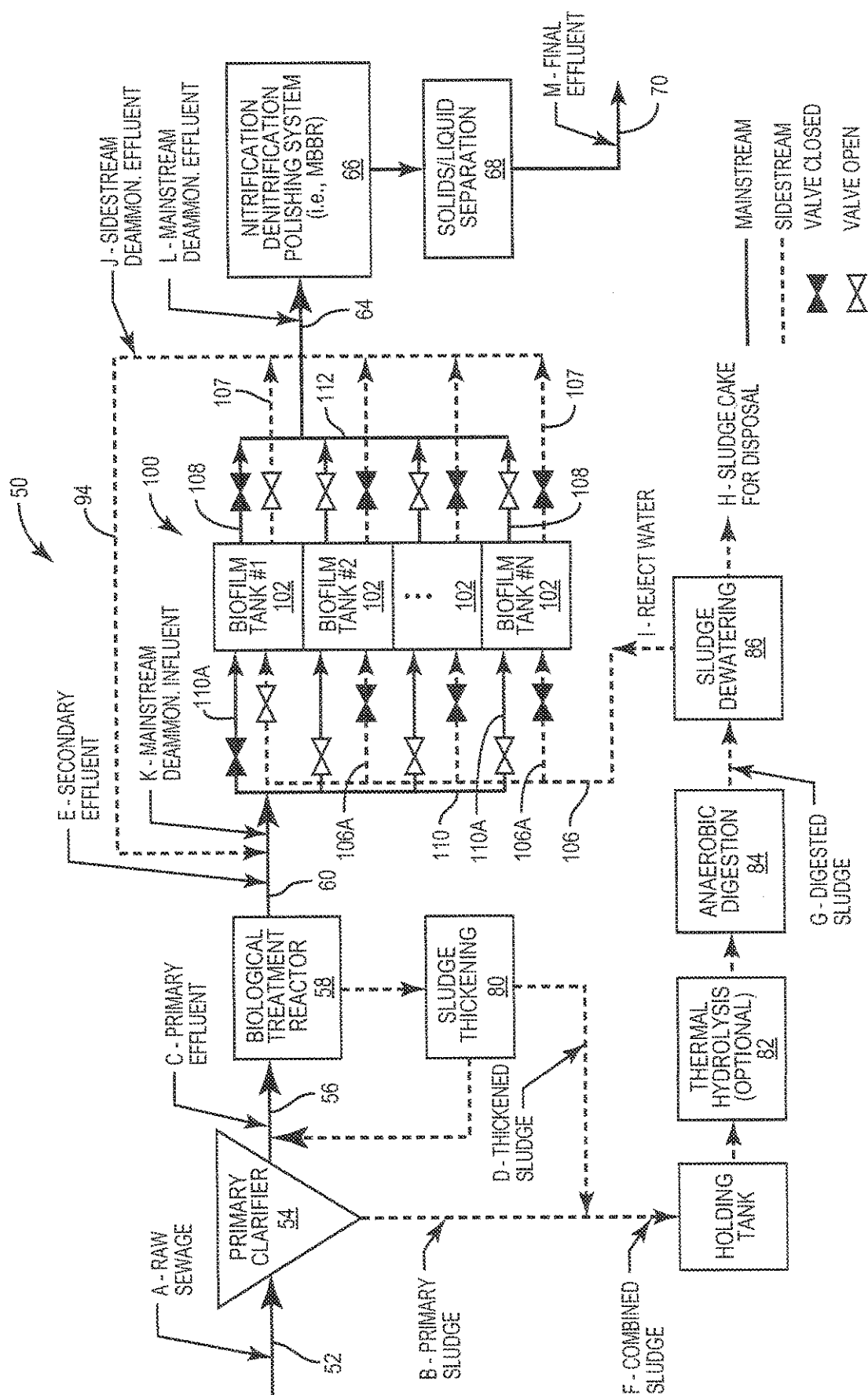
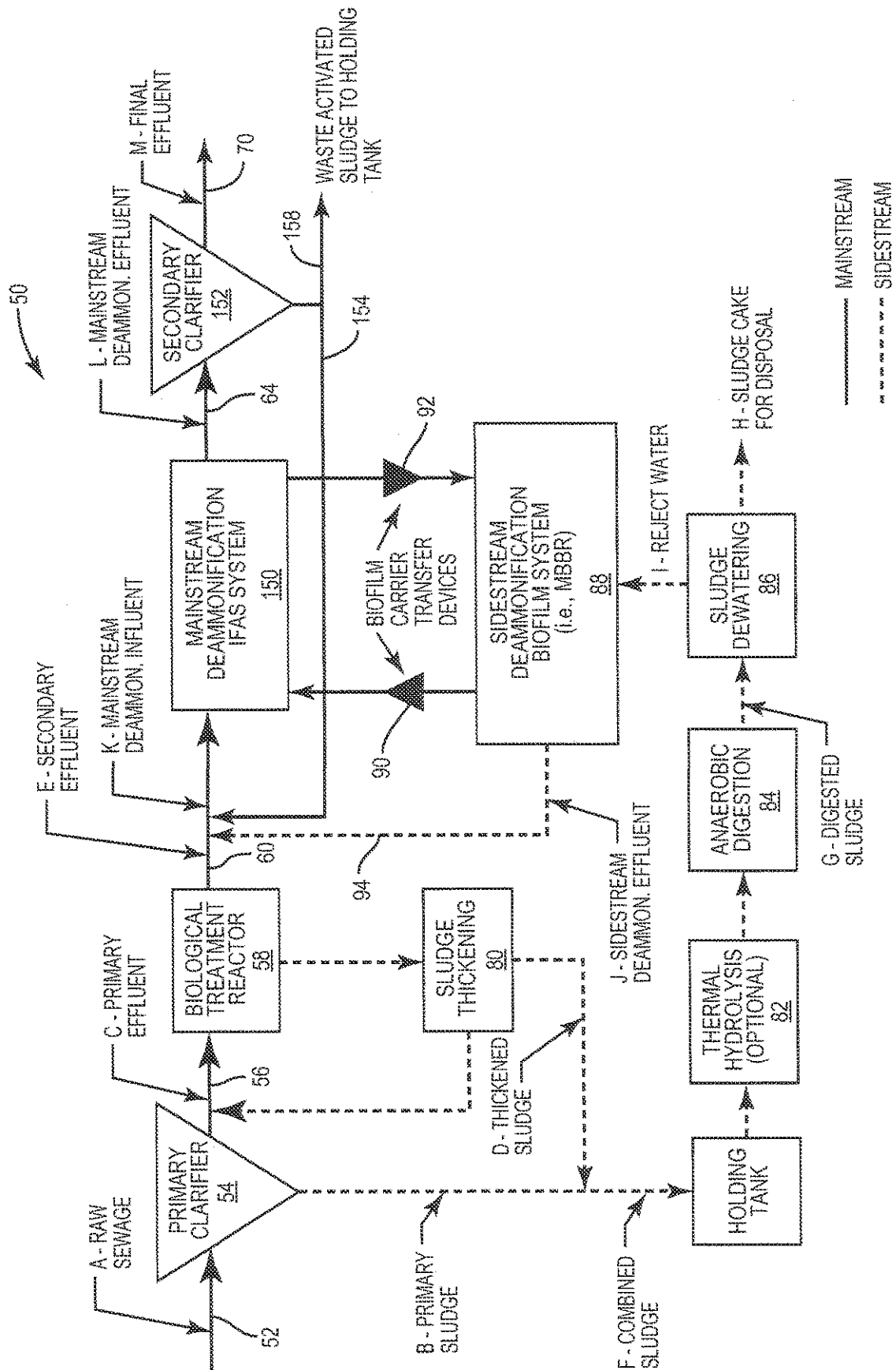


FIG. 2



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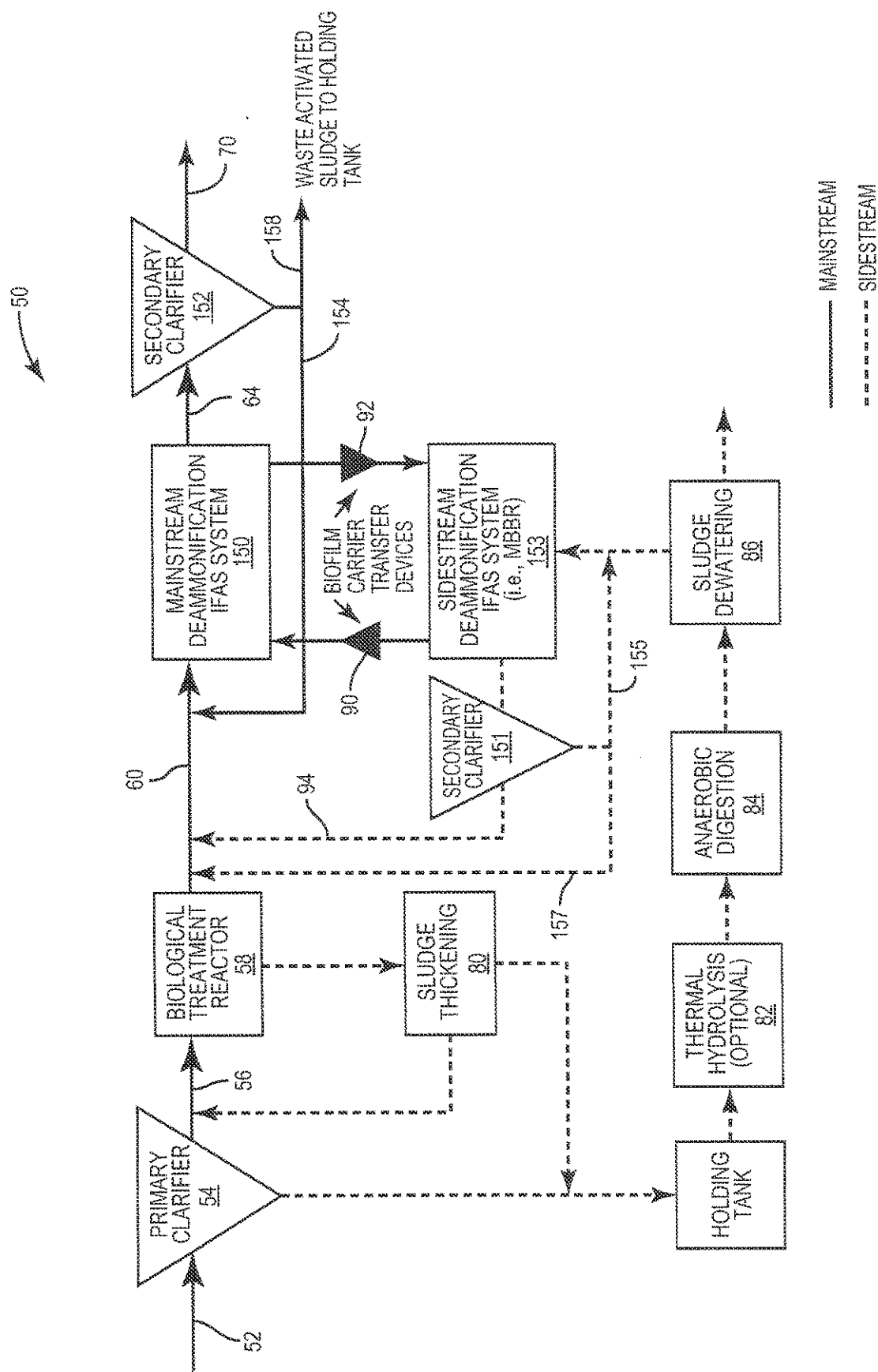


FIG. 4

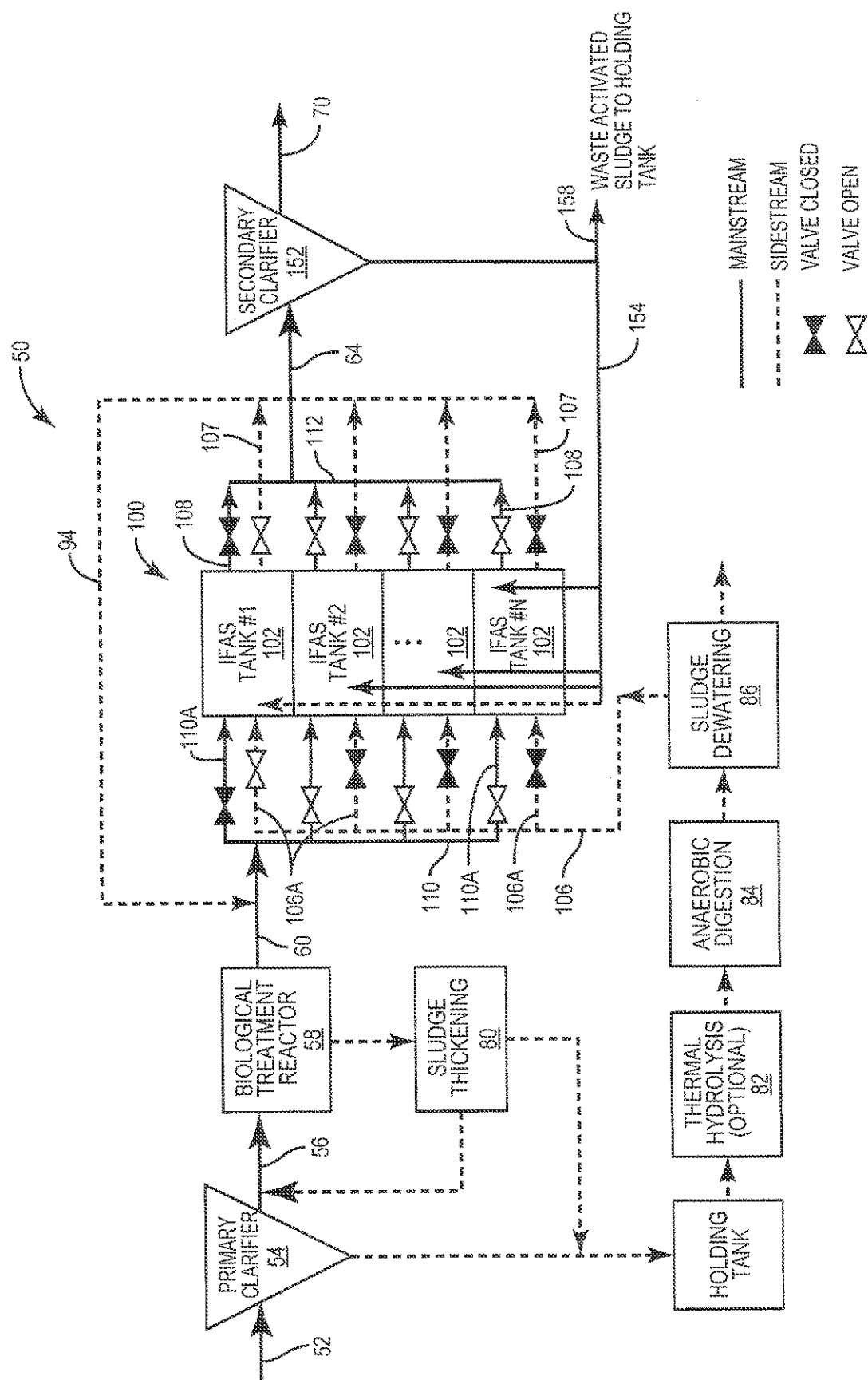


FIG. 5

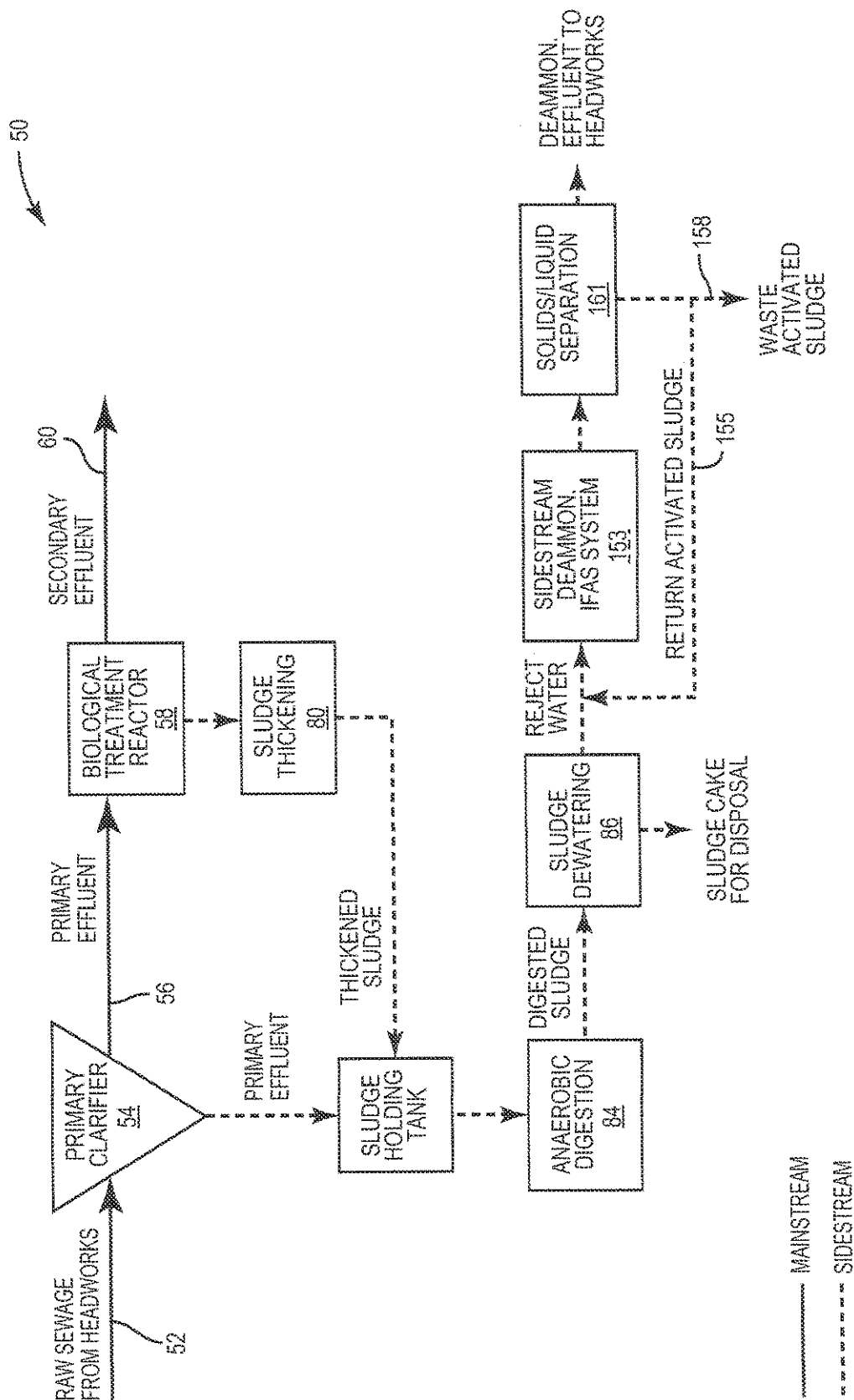


FIG. 6

DEAMMONIFICATION PROCESS WITHOUT THERMAL HYDROLYSIS

STREAM #	STREAM NAME	FLOW MGD	NH ₄ -N		NO _x -N		BIOD. Org-N		NON-BIOD. Org-N		TOTAL NITROGEN		NOTES
			mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	
A	RAW SEWAGE	1.0	55	459	0	0	23	192	2	17	80	667	Typical High Strength Municipal Sewage
B	PRIMARY SLUDGE	0.01					1,200	100					15% of TN removal by Primary Clarifier
C	PRIMARY EFFLUENT	1.0	55	459	0	0	11	92	2	17	68	567	
D	THICKENED SECONDARY SLUDGE	0.005					2,950	123			2,950	123	N assimilation = 6% of BOD by BOD removal only system; Primary effluent BOD = 245 mg/L
E	SECONDARY EFFLUENT	1.0	51	427	0	0	0	0	2	17	53	444	All biod. Org-N is converted to ammonia after secondary biological treatment
F	COMBINED SLUDGE	0.015					1,783	223			1,783	223	Prim sludge + secondary sludge
G	ANAEROBIC DIGESTED SLUDGE	0.015	895	112	0	0	888	111			1,783	233	Without THP, 50% of org-N in the sludge is released as ammonia, 50% org-N remains in sludge.
H	SLUDGE CAKE							105				105	Without THP, 95% of org-N in the digested ends up in sludge cake. Cake flow rate is negligible
I	REJECT WATER FROM DEWATERING	0.02	671	112	0	0	0	0	36	6	707	118	0.005 MGD wash water is added during dewatering, 5% of org-N in the digested sludge is soluble and not biodegradable
J	SIDESTREAM DEAMMON. EFFLUENT	0.02	100	16.8	57	9.5	0	0	36	6	192	32	About 85% removal for ammonia and 75% for TN removal and 10% nitrate is produced during anammox process.
K	MAINSTREAM DEAMMON. INFLUENT	1.0	53	444	1.1	9.5	0	0	2.8	23	57	476	Combined Streams = secondary effluent + sidestream effluent
L	MAINSTREAM DEAMMON. EFFLUENT	1.0	10	83	5.5	36+ 9.5	0	0	2.8	23	18.0	152	Effluent ammonia at 10 mg/L is expected for mainstream deammon. 10% of nitrate is produced during the anammox process.
M	FINAL EFFLUENT	1.0	1.0	8.3	1.0	8.3	0	0	2.8	23	4.8	40	1 mg/L ammonia & 1 mg/L nitrate of final effluent can be achieved with conventional BNR processes

FIG. 7

DEAMMONIFICATION PROCESS WITH THERMAL HYDROLYSIS

STREAM #	STREAM NAME	FLOW MGD	NH ₄ -N		NO _x -N		BIOD. Org-N		NON-BIOD. Org-N		TOTAL NITROGEN		NOTES
			mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	
A	RAW SEWAGE	1.0	55	459	0	0	23	192	2	17	80	667	Typical High Strength Municipal Sewage
B	PRIMARY SLUDGE	0.01					1,200	100					15% of TN removal by Primary Clarifier
C	PRIMARY EFFLUENT	1.0	55	459	0	0	11	92	2	17	68	567	
D	THICKENED SECONDARY SLUDGE	0.005					2,950	123			2,950	123	N assimilation = 6% of BOD by BOD removal only system; Primary effluent BOD = 245 mg/L
E	SECONDARY EFFLUENT	1.0	51	427	0	0	0	0	2	17	53	444	All biod. Org-N is converted to ammonia after secondary biological treatment
F	COMBINED SLUDGE	0.015					1,783	223			1,783	223	Prim sludge + secondary sludge
G	ANAEROBIC DIGESTED SLUDGE	0.015	1,335	167	0	0	448	56			1,783	223	Without THP, 75% of org-N in the sludge is released as ammonia, 25% org-N remains in sludge.
H	SLUDGE CAKE							39				39	With THP, 70% of org-N in the digested ends up in sludge cake. Cake flow rate is negligible
I	REJECT WATER FROM DEWATERING	0.02	1,001	167	0	0	0	0	102	17	1,103	184	0.005 MGD wash water is added during dewatering, 30% of org-N in the digested sludge is soluble and not biodegradable
J	SIDESTREAM DEAMMON. EFFLUENT	0.02	150	25	84	14	0	0	102	17	335	56	About 85% removal for ammonia and 75% for TN removal and 10% nitrate is produced during anammox process.
K	MAINSTREAM DEAMMON. INFLUENT	1.0	54	452	1.7	14	0	0	4.0	34	60	500	Combined Streams = secondary effluent + sidestream effluent
L	MAINSTREAM DEAMMON. EFFLUENT	1.0	10	83	6.0	14+ 37	0	0	4.0	34	20	168	Effluent ammonia at 10 mg/L is expected for mainstream deammon. 10% of nitrate is produced during the anammox process.
M	FINAL EFFLUENT	1.0	1.0	8.3	1.0	8.3	0	0	4.0	34	6.0	50.6	1 mg/L ammonia & 1 mg/L nitrate of final effluent can be achieved with conventional BNR processes

FIG. 8

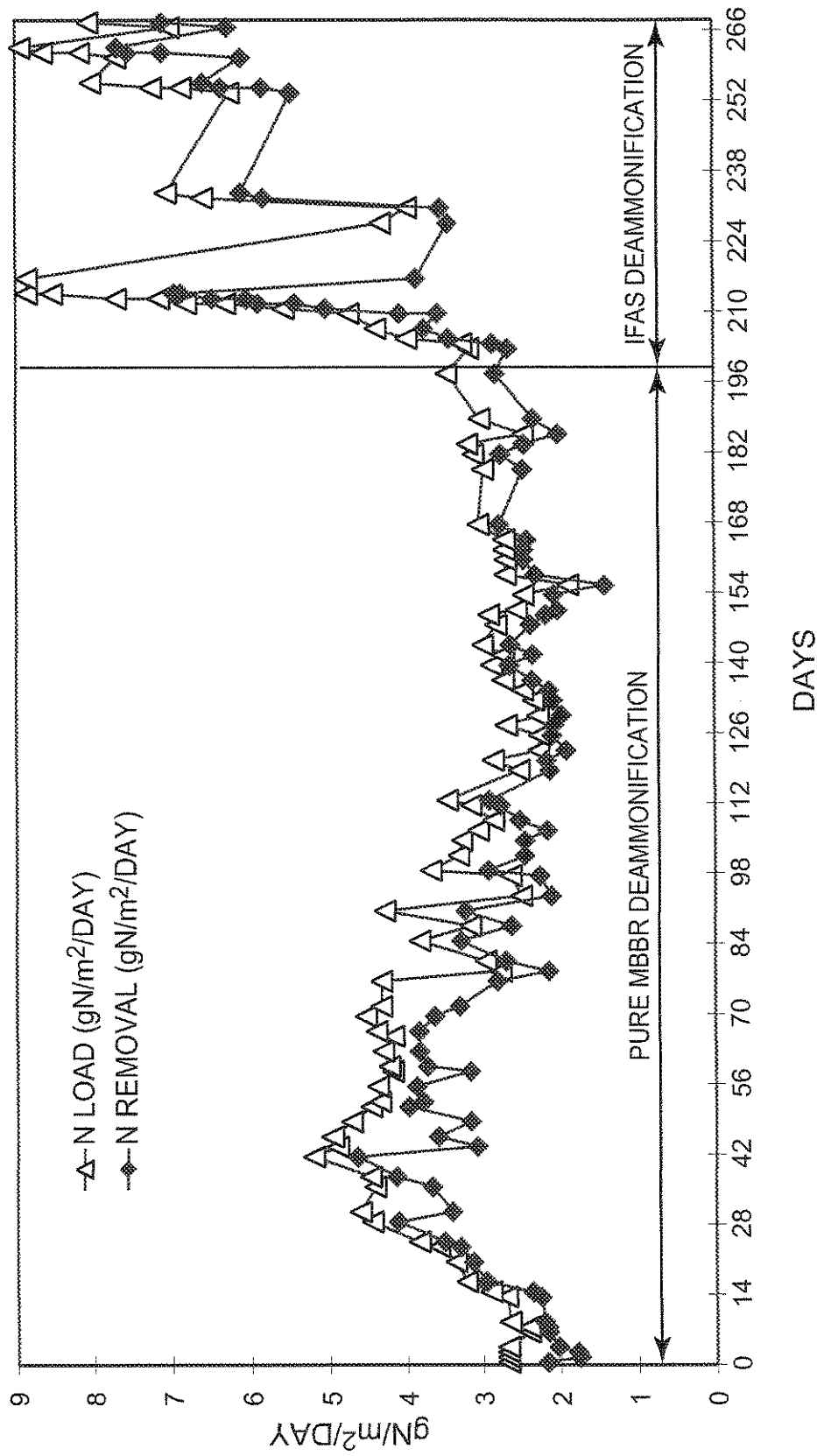


FIG. 9